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EMERGENCY PLAN FOR PINE RIVER DAM AND RESERVOIR

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

This plan implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for actions to identify and mitigate or respond to various types of emergencies which, while rare, could occur in the operation of Pine River Dam.

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CENCS-ED-M

30 NOV 1990
Sandquist

MEMEORANDUM FOR DISTRIBUTION

SUBJECT: Pine River Dam Emergency Action Plan Distribution

Copies of the completed emergency action plans for Pine River Dam are enclosed for your reference. This report implements the Corps program to prepare emergency action plans for all dams. It provides a guide for identifying, mitigating, or responding to various types of emergencies which, although unlikely, could occur during the operation of the dam.

Please contact me at (612)220-0657 with any questions, comments, or requests for additional plans.

Stephen F. Sandquist

STEPHEN F. SANDQUIST
Engineer Manager

EMERGENCY PLAN DISTRIBUTION

for Pine River Dam

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Asst. Chief ED	1
ED-D	1
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Headwaters Area Office	2
Pine River Dam Office	4
Total	20 EA

C23 4/15
STEVE

NOV 0 9 1990

CENCD-PE-ED-WH (CENCS-ED-M/28 Sep 90) (1130-2-419) 1st End
Mr. John Vento/pz/(312) 353-7132
SUBJECT: Emergency Plan for Pine River at Cross Lake, Minnesota

Commander, North Central Division, U.S. Army Corps of Engineers,
ATTN: CENCD-ED, 536 South Clark Street, Chicago, IL 60605-1592

FOR Commander, St. Paul District, ATTN: CENCS-ED-M

1. The subject Emergency Plan, which includes a revised emergency notification subplan, is approved.

2. The updated notification subplan, which was revised based on experience from the Gull Lake failure exercise, should be adopted as a standard for all emergency plans in your district. This subplan should be incorporated into your other project's emergency plans as they are periodically updated.

3. The HQ, NCD POC is John Vento, (312) 353-2579.

FOR THE COMMANDER:

Encls wd

MALCOLM J. TODD, P.E.
Acting Chief, Engineering Division

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
1421 U.S. POST OFFICE & CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101-9806

REPLY TO
ATTENTION OF

CENCS-ED-M (350-3-2a) 28 September 1990

MEMORANDUM FOR Commander, North Central Division, Corps of Engineers, ATTN: CENCD-ED-WH/John Vento, 536 South Clark Street, Chicago, Illinois 60605-1592

SUBJECT: Emergency Plan for Pine River at Cross Lake, Minnesota

1. Subject Report is submitted in accordance with Engineer Regulation 1130-2-419.

2. This report implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for identifying, mitigating, or responding to various types of emergencies, which, although unlikely, could occur during the operation of Pine River. The Pine River Dam EAP has been informally approved previously. All recommended changes have been incorporated into this report.

3. Please contact Mr. Steve Sandquist at (612) 220-0657 if you have any questions.

FOR THE COMMANDER:

Stan Kempula

2 Encls
EAP, Orwell Dam (2 cys)

for ROBERT F. POST
Chief, Engineering Division

EMERGENCY ACTION PLAN

FOR

PINE RIVER DAM AND RESERVOIR

PREPARED BY THE

ST. PAUL DISTRICT

U.S. ARMY CORPS OF ENGINEERS

SEPTEMBER 1990

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EMERGENCY ACTION PLAN
FOR
PINE RIVER DAM AND RESERVOIR

1. Introduction

Much of the land surrounding Pine River Reservoir that would be inundated by the PMF (probable maximum flood) is not in Federal ownership. Therefore, the possibility exists that high water levels could cause a hazard to life and private property in the vicinity of the reservoir. In addition, a failure of the dam or embankment during normal pool low flow conditions could result in the sudden release of a large volume of water from Pine River Reservoir that could threaten life and property in the project area and surrounding lands.

a. Purpose

This plan implements the Corps program to prepare emergency plans for all Corps dams. It provides a guide for actions to identify and mitigate or respond to various types of emergencies, which, while rare, could occur in the operation of Pine River Dam. Specific information on emergency actions to be taken is provided in the following appendixes:

(1) APPENDIX A, Emergency Identification Subplan.

(2) APPENDIX B, Emergency Operations and Repair Subplan.

(3) APPENDIX C, Emergency Notification Subplan.

(4) APPENDIX D, Inundation Map Package.

b. Applicability

The emergency plan applies to all Corps elements and field offices concerned with operation of Pine River Dam.

c. References

(1) ER 1130-2-419, Dam Operations Management Policy, U.S. Army Corps of Engineers, 18 May 1979.

(2) ER 1130-2-417, Major Rehabilitation Program and Dam Safety Assurance Program, U.S. Army Corps of Engineers, revised edition, 1980.

(3) ER 1130-2-419, Change 1 Project Operation: Dam Operation Management Policy, U.S. Army Corps of Engineers, 9 April 1982.

(4) Director of Civil Works multiple-addressed letter, 20 March 1978, subject: Evacuation Plans for Areas Downstream of Corps Dams and Corps/State Cooperation on Safety Review of Corps Dams.

(5) Flood Emergency Plan for Lock and Dam 6, U.S. Army Corps of Engineers, St. Paul District, 1986.

(6) Flood Emergency Plan for Lock and Dam 5, U.S. Army Corps of Engineers, St. Paul District, 1986.

(7) Creativity, Conflict and Controversy: A History of the St. Paul District U.S. Army Corps of Engineers, Raymond H. Merritt, U.S. Government Printing Office, 1979.

(8) Flood Emergency Plan for Lock and Dam 10, U.S. Army Corps of Engineers, St. Paul District, 1983.

(9) Mississippi River Headwaters Project, Apperdix V: Pine River Dam and Reservoir, Reservoir Regulation Manual, U.S. Army Corps of Engineers, St. Paul District, 1985.

(10) Mississippi River Headwaters Dams, Master Regulation Manual, St. Paul District, U.S. Army Corps of Engineers, 1963.

(11) Flood Hydrograph Package, HEC-1, U.S. Army Corps of Engineers, Hydrologic Engineering Center, Davis, California, September 1981.

(12) Research Document No. 19, Example Emergency Plan for Blue Marsh Dam and Lake, U.S. Army Corps of Engineers, St. Paul District, August 1983.

(13) Flood Emergency Plans, Guidelines for Corps Dams, Hydrologic Engineering Center, Water Resources Support Center, Davis, California, June 1980.

(14) Federal Guidelines for Dam Safety, Prepared by Ad Hoc Interagency Committee on Dam Safety of the Federal Coordinating Council for Science, Engineering and Technology, Washington, D.C., 25 June 1979.

(15) Emergency Plan for Winnibigoshish Dam and Reservoir, U.S. Army Corps of Engineers, St. Paul District, October 1985.

(16) Mississippi River Headwaters Lakes in Minnesota, Feasibility Study: Main Report, U.S. Army Corps of Engineers, St. Paul District, September 1982.

(17) Pine River Dam Risk Assessment, Pine River Dam, Cross Lake, Minnesota, U.S. Army Corps of Engineers, St. Paul District, September 1987.

(18) CENCS-ED-GH (1110-2-1403), Headwaters Perimeter Dikes, Dam Safety Recommendations, U.S. Army Corps of Engineers, St. Paul District, 18 February 1988.

(19) Mississippi River Headwaters Reservoirs, Master Plan for Public Use Development and Resource Management, St. Paul District, U.S. Army Corps of Engineers, August 1977.

(20) Earth Manual, Second Edition, U.S. Department of the Interior Water and Power Resources Service Reprint.

(21) Lambe, T. William and Robert V. Whitman, 1969, Soil Mechanics, John Wiley & Sons, New York.

(22) Emergency Plan for Pokegama Dam and Reservoir, U.S. Army Corps of Engineers, St. Paul District, March 1987.

(23) IWR Report 86-R-7, Guidelines for Evaluating Modifications of Existing Dams Related to Hydraulic Deficiencies, U.S. Army Corps of Engineers, September 1986.

(24) Emergency Plan for Lock and Dam 1, Minneapolis, Minnesota, U.S. Army Corps of Engineers. St. Paul District, March 1987.

(25) Emergency Plan for Pine River Dam and Reservoir, U.S. Army Corps of Engineers, St. Paul District, May 1987.

(26) Emergency Plan for Locks and Dams at St. Anthony Falls, Minneapolis, Minnesota, U.S. Army Corps of Engineers, St. Paul District, March 1987.

(27) Reconnaissance Report for Dam Safety Assurance Program, Pine River Dam, Cross Lake, Minnesota, U.S. Army Corps of Engineers, St. Paul District, October 1987.

(28) Emergency Plan for Sandy Lake Dam and Reservoir, U.S. Army Corps of Engineers, St. Paul District, June 1987.

d. Scope

This plan addresses emergencies related to above normal reservoir water levels and/or greater than normal discharge of water from the reservoir. It also addresses identification of impending or existing emergencies, notification of other parties concerning impending or existing emergencies, and emergency operations and repairs. Areas potentially affected by emergencies are identified for the cases of PMF without dam failure, with dam failure, and dam failure at normal high pool level (top of flood control pool).

e. Datum

All elevation readings contained in this report have the designation National Geodetic Vertical Datum (NGVD) 1929.

f. Definitions

(1) Preemergency

A preemergency condition is one in which some impending or existing threat to the safe operation of the dam and reservoir is recognized but no

significant hazard to life or property is expected. Notification of other Corps offices is required upon declaration of a preemergency.

(2) Emergency

An emergency condition is one in which the occurrence of a significant hazard to life or property is very probable or certain. Conditions justifying declaration of an emergency may be imminent, such as breach of the dam or uncontrollable piping, or longer term, such as predicted large inflows. Warnings to evacuate are required upon declaration of an emergency.

2. Description of Project Area

a. Location

Pine River Reservoir is one of six Mississippi River Headwaters Reservoirs in north central Minnesota. Pine River Dam is on the Pine River at the outlet of Cross Lake, 16 river miles above the junction of the Pine and Mississippi Rivers, 199.0 Mississippi River miles above St. Paul, Minnesota, and 1,038.3 Mississippi River miles above the mouth of the Ohio River. The dam is at the community of Cross Lake, Minnesota, and is often referred to as the Cross Lake Dam. A general location map and general plan of Pine River Dam and Reservoir are on plates 1 and 2.

b. Topography

The land elevation in the Pine River watershed varies from elevation 1570 feet in the north to elevation 1229 feet at the reservoir. The topography is typical of glacial effects, mostly level with gentle rolling hills. The slopes around the shoreline of Pine River Reservoir vary from near vertical cliffs to slopes of about 6 percent.

c. Geology

The Upper Mississippi River basin is underlain by a series of Precambrian igneous and metamorphic rocks. The area surrounding Pine River Reservoir consists primarily of glacial outwash with a dominant moraine in the eastern portion and areas of till plain to the south. The soils in the area of the reservoir are predominantly sand and clay with fair to poor fertility. A red drift region approximately 200 to 300 feet thick covers the reservoir area.

d. Climate

The climate of the Headwaters area is characterized by long severe winters with snow on the ground from November to March. The mean annual snowfall is 51.61 inches, and the mean annual precipitation is 27.31 inches. Extreme temperatures range from -53°F to 104°F. Normally, December through February are the driest months, while the greatest amount of precipitation occurs during June and July.

e. Description of the Pine River Watershed

The Pine River Reservoir controls the runoff from a 562-square-mile basin 90 miles west of Duluth, Minnesota, and 120 miles northwest of Minneapolis, Minnesota. The watershed shares a common boundary with Leech Lake Reservoir basin to the north and Gull Lake Reservoir basin to the south. Its extent is about 20 miles north to south and 30 miles east to west.

The water in the Pine River Reservoir includes 15 natural lakes and originates from three main rivers. The reservoir at normal pool has an area of 21 square miles (13,600 acres). Pine River begins at about elevation 1395 feet in a small lake in the northwest portion of the basin and joins with the South Fork of the Pine River from the west and flows into the reservoir at the west end. The average river slope is 4.7 feet per mile. Daggett Creek drains the northeastern portion of the watershed and flows into the east end of the reservoir. The Pine River has a total length of about 45 miles and flows through parts of Cass and Crow Wing Counties enroute to the Mississippi River. The principal tributaries below the Pine River Dam are Pelican Brook and the Little Pine River.

The land around the reservoir is almost completely forested. Along the shoreline, the ground generally rises dramatically from the water and is densely covered with pine and hardwoods, such as oak and birch. More than 50 percent of the shoreline is comprised of Norway, white and jack pine.

3. Description of Project Features

Pine River Dam and Reservoir went into operation in 1886. The original purpose of the reservoir was augmentation of Mississippi River discharges during low-flow periods to improve navigation between St. Paul and Lake Pepin near Lake City, Minnesota. The reservoir also provides flood control, recreation, water supply, and fish and wildlife habitat. The lakes that are part of the reservoir are Cross, Daggett, Little Pine, Rush, Island, Big Trout, Lower Whitefish, Upper Whitefish, Arrowhead, Clamshell, Bertha, Lower Hay, Ox, Loon, and Pig. These lakes are generally connected by shallow, narrow channels, maintained to allow boat passage.

a. Pine River Dam

Pine River Dam is an earth dike. The total length of the dam, excluding the control structure, is 1,265 feet. Pertinent data for Pine River Dam and Reservoir are in table 1.

Table 1 - Pertinent data, Pine River Dam and Reservoir

Reservoir	
At project pool:	Elevation 1229.32 feet
Surface area	13,600 acres
Shoreline	112 miles
Length	8.4 miles (maximum)
Storage capacity at normal pool	101,340 acre-feet
Total drainage area	562 square miles
Dam	
Type	Earthfilled with timber diaphragm
Length	1,265.0 feet
Top of dam elevation	1237.3 feet
Top width	Embankment is 8 feet
Maximum height	20.9 feet
Freeboard at maximum design pool stage	2.9 feet (embankment); 2.0 feet (outlet structure)
Freeboard at normal pool (1229.32)	7.9 feet (embankment); 7.0 feet (outlet structure)
Perimeter dikes	16 dikes in low areas to prevent loss of impounded water; 7,390 feet total length; height generally less than 20 feet, minimum top elevation 1238.1 feet. Adjacent areas are as low as elevation 1235.1 feet.
Outlet Structure	
Sluice gates	11 slide gate openings 4-1/2 feet wide by 5 feet high
Log sluices	Two 6.0-foot-wide stop-log bays
Elevation of stop logs at normal pool	1231.82 feet
Maximum discharge capacity at maximum project pool (EL 1234.3)	5,600 CFS
Top elevation	1236.32 feet (top or roadway)
Outlet Structure Apron	
Type	Concrete supported on wood piling
Floor elevation	1216.65 feet
Length	86.0 feet
Floor slab	16-inch concrete slab
Width	150.0 feet

b. Control Structure

The Pine River Dam control structure is made of reinforced concrete and is supported on a timber substructure filled with puddled clay. The structure is 150 feet wide between abutments and has a net spillway width of 78 feet. The spillway consists of 13 sluiceways, 6 feet wide, 11 of which are slide gate-bays and 2 of which are stop-log bays. The slide gates are 5.0 feet high from sill to bulkhead and 4.5 feet wide. The sill elevation of the gated bays is 1217.32 feet. The elevations of the top of the concrete piers is 1235.82 feet. There is an 8.0-foot-wide roadway with a top elevation of 1236.32 feet on the structure. Cross sections of the control structure are presented on plate 3.

c. Perimeter Dikes

There are 16 perimeter dikes with top elevations greater than 1238.1 feet, having a combined total length of 7,390 feet. These dikes are designed to prevent uncontrolled overflow of stored water through naturally lower areas during extreme floods. The locations of the perimeter dikes are illustrated on plate 4. In some cases, the elevation of natural ground adjacent to the perimeter dikes is lower than the dike crest. The lowest elevation at which overflow could occur at or adjacent to a perimeter dike is 1235.1 feet.

All of the Pine River Reservoir dikes except dikes 2, 3, 12, and 16 are part of the road system in the Pine River Reservoir area. Only dike 16 is protected with riprap. The dikes are marked with numbered fence posts at each end and signs. Pertinent perimeter dike data are presented in table 2.

d. Pine River Reservoir

The present operating schedule for Pine River Reservoir is designed to maintain the reservoir level during the summer resort season at elevation 1229.32 $\pm$ 0.25 foot to satisfy local interests. At the normal summer elevation, the reservoir storage volume is 101,340 acre-feet, and 27,800 acre-feet of storage is available below the maximum operating elevation. The reservoir storage volume at the maximum operating elevation of 1231.32 feet is 129,130 acre-feet. Drawdown to elevation 1227.32 feet during the winter provides 54,000 acre-feet to store spring runoff. The maximum storage ever attained on Pine River Reservoir was 175,000 acre-feet at a stage of 18.41 feet (elevation 1234.73 feet) during the 1916 flood.

e. Public Use Areas

The Ronald Louis Cloutier Recreation Area (42 acres of land) is located at Pine River Dam. The average elevation of the site is almost 6 feet above the average pool elevation. The recreation area facilities consist of 117 campsites, two of which are designed for handicap use; 40 picnic units; a day-use area; and parking for 60 vehicles. The facilities also include swimming beaches, boat docks and launches, a shower building, and a playground.

Table 2 - Pertinent data, perimeter dikes

Dike #	Top width (feet)	Length (feet)	Maximum height (feet)	Lake side slope protection	Existing controlling dike elevation[1]	Existing dike side slope	
						Lake	Land
1	45	360	20	Brush	1243.2	1 on 5	1 on 5
2	50	450	20	Trees	1242.0	1 on 5	1 on 4
3	50	540	15	Trees	1238.1	1 on 8	1 on 5
4	50	390	10	Grass	1239.7[2]	1 on 14	1 on 6
5	50	800	15	Grass	1239.9	1 on 4	1 on 4
6	50	1,100	15	Grass	1241.0	1 on 4	1 on 4
7	50	300	15	Grass	1242.0[3]	1 on 3	1 on 4
8	50	400	15	Grass	1242.9[4]	1 on 4	1 on 5
9	50	300	15	Trees	1242.3	1 on 3	1 on 4
10	50	200	20	Brush	1242.1[5]	1 on 5	1 on 4
11	35	1,000	20	Trees	1238.5	1 on 4	1 on 4
12	20	100	10	Trees	1242.9[6]	1 on 4	1 on 4
13	50	1,000	20	Trees	1242.9	1 on 3	1 on 4
14	50	150	20	Trees	1240.7	1 on 6	1 on 3
15	50	150	20	Trees	1242.9	1 on 5	1 on 4
16	20	150	15	Riprap	1240.6	1 on 4	1 on 4

(1) Compare to: Required minimum top of dike, SDF elevation + 3.0 feet = 1237.3 feet. Normal pool elevation, highest summer range = 1229.57 feet. Maximum observed pool elevation = 1234.73 feet, 7 July 1916.

(2) Dikes 3 and 4 are connected and elevation 1238.1 feet at dike 3 controls.

(3) Elevation 1241.2 feet adjacent to dike 7 controls.

(4) Elevation 1241.2 feet adjacent to dike 7 controls.

(5) Elevation 1235.1 feet adjacent to dike 10 controls.

(6) Elevation 1239.3 feet adjacent to dike 12 controls.

The Clamshell Recreation Area is 12 miles west of Cross Lake on County Road 16. It consists of 5 acres of land on the north shore of Clamshell Lake. Facilities include a launching ramp, boat dock, two vault toilets, five picnic grills, and tables and parking for 23 automobiles and boat trailers. No overnight camping facilities are provided.

The Big Trout Lake Recreation Area is 5 miles north of Cross Lake on County Road 6. It consists of 23.7 acres of land on the east shore of Big Trout Lake in Manhattan Beach, Minnesota. Facilities include a launching ramp, boat dock, swimming beach, and parking lot for 10 automobiles and trailers. No overnight camping facilities are provided.

In addition to the three recreation areas described above, a proposed recreation area is on the east side of Arrowhead Lake about 6 miles from Pine River Dam. It consists of approximately 39 acres of land above the average pool elevation. The area is heavily wooded with birch and pine and is accessible from CSAH (County State Aid Highways) 1 and 134. Plans for this facility call for the future development of an upgraded access road, boat launch ramp, two vault toilets, water well, picnic tables and fireplaces, and parking for 20 cars and trailers. No overnight camping facilities are anticipated.

f. Instrumentation

Instrumentation in the area of Pine River Dam includes three daily recording climatological data stations, one at the damsite; one at Deep Portage, Minnesota; and one at Backus, Minnesota. These National Weather Service gages are read daily. Two Leupold Stevens recording gages at Pine River Dam record pool level and tail-water level.

Water quality and sedimentation are not monitored in the Pine River Reservoir basin.

g. Operations and Maintenance

Pine River Dam and Reservoir is owned by the U.S. Army Corps of Engineers and operated and maintained by the St. Paul District's Project Operations Branch. A resource manager resides close to the dam to carry out operations and routine repairs. Lands held in fee title by the Federal Government amount to 475.58 acres in addition to flowage easements on another 21,708 acres at Pine River Reservoir. The Corps of Engineers has jurisdiction over a number of scattered parcels besides the Ronald Louis Cloutier Recreation Area at the dam. These parcels include lands on South Cross Lake Bay, Clamshell Lake, Upper Whitefish Lake, Arrowhead Lake, Big Trout Lake, and Rush Lake.

Hydrologic forecasting for public use is the responsibility of the National Weather Service.

4. Potentially Affected Project Areas

Potentially affected project areas are all lands under the control of the Corps of Engineers and potentially affected by emergencies at Pine River Dam and Reservoir. Pine River Dam and all dams downstream on the Mississippi River could be affected by increased flows as a result of an emergency at Pine River Dam.

a. Reservoir Surface

Pine River Dam is designed to maintain a reservoir elevation of 1229.32 feet. The surface area of the reservoir at the average pool elevation is 13,600 acres. Dangers to those on the reservoir as a result of an emergency could include strong surface currents in the event of a dam break or flow over the dam crest. The channels between lakes and the dam vicinity could be the site of such currents.

b. Ronald Louis Cloutier Recreation Area

The elevation of the Ronald Louis Cloutier Recreation Area averages just over 6 feet above the normal reservoir elevation. High reservoir levels resulting from a flood could inundate parts of the recreation area. Historic high-water levels have resulted in minimal damage to the recreational area.

c. Clamshell Recreational Area

High reservoir levels could inundate a portion of this recreational area.

5. Potentially Affected Nonproject Areas

Potentially affected nonproject areas are all areas not under the control of the Corps of Engineers that could be affected by an emergency at Pine River Dam. This category includes all the communities listed in section 10 of this report and those regions reported in this section.

a. Vicinity of the Reservoir

Much of the land surrounding the Pine River Reservoir is private land with many residences and cabins. The potential for damage in the vicinity of the Pine River Reservoir as a result of high reservoir levels during a flood is great.

b. Pelican Brook Basin

Low areas in the Pelican Brook basin, which is southwest of the reservoir, could be inundated as a result of the failure of dikes 13, 14, or 15 or the natural watershed divide between the dikes. The level of the lakes below dikes 13, 14, and 15 could rise significantly as a result of a failure.

For example, the water level of Star Lake, a small lake in the Pelican Brook basin, is normally 23 feet below the level of the Pine River Reservoir. Between Pine River reservoir and Star Lake is the natural watershed divide and perimeter dikes 13 and 14. Failure of these dikes or the natural divide could cause the Star Lake water level to rise about 20 feet in less than 24 hours. Such a failure could pose a serious threat to lives and property on Star Lake. Other lakes below dikes 13, 14, and 15 that would be threatened by such a failure are Dew Drop Lake, Pleasant Lake, Peck's Puddle, Hooligans Hole, Little Beaver Lake, Henry Lake, Little Star Lake, Bass Lake, Kimble Lake, Strawberry Lake, Ossawinnamakee Lake, Clear Lake, and Grass Lake.

c. Pine River between the Pine River Dam and the Mississippi River

Low areas near Pine River between the Pine River Dam and the confluence of the Pine and Mississippi Rivers could be inundated by a major flood. Cross Lake, which is near the damsite, would be inundated by rising reservoir levels or high water levels in Pine River.

Farther downstream, the inundation area during the PMF includes areas adjacent to Velvet Lake, Big Bird Lake, Greer Lake, Big Pine Lake, Bass Lake, and Google Lake. The water surface level of Big Pine Lake, which is about 3 miles downstream of the Pine River Dam, would rise about 25 feet as a result of the PMF. The flooding would inundate the residences and cabins on Big Pine Lake, with potential for property damage and loss of life.

The PMF would inundate all bridges that cross the Pine River in this reach. The bridges are the Crow Wing County Road 3 bridge (near the dam), Crow Wing County Road 36 bridge (2 miles downstream from the dam), and now Crow Wing County Road 11 bridge (16 miles downstream from the dam).

d. Brainerd, Minnesota

Brainerd, Minnesota, is on the Mississippi River downstream of the confluence of the Pine and Mississippi Rivers. Floods on Pine River would affect Mississippi River levels in Brainerd. Brainerd is built high above the Mississippi River and would not be affected seriously by elevated water levels.

e. Mississippi River Below Brainerd

Floods on Pine River could affect river levels of the Mississippi River below Brainerd.

6. Potential Causes of an Emergency

The following potential causes of an emergency affecting the operation or safety of Pine River Dam and Reservoir were selected for planning:

a. Excessive seepage.

b. Sabotage.

c. Extreme storm.

d. Slope failure.

e. Foundation failure.

Each item is discussed briefly in the following paragraphs.

a. Excessive Seepage

A potential exists for seepage through, around, or under the dam and perimeter dikes. Some seepage is normal and not considered hazardous. However, seepage that increases in amount or contains suspended solids may indicate that piping is occurring and piping can lead to a dike breach. Seepage problems are usually controllable.

b. Sabotage

Sabotage could affect operation of the dam by disrupting communications, disabling gate controls or equipment, breaching the dam, or various combinations of the foregoing. Only breaching of the dam, by use of explosives for instance, could cause the sudden dangerous release of water.

c. Extreme Storm

An extreme storm could occur in the area of the reservoir or the watershed upstream of the reservoir. An extreme storm could result in large inflows to the reservoir, causing a high reservoir level, great discharges through and over the outlet structure, and/or large waves on the reservoir surface. The potential for mitigating such problems depends on their severity and other circumstances.

d. Slope Failure

A sliding or sloughing of the face of an earth embankment could occur. A slope failure that extended to the top of the embankment would effectively lower the crest. This could result in the sudden release of a large volume of water if the reservoir water surface exceeded the elevation of the resulting embankment crest. Control of slope failure problems depends on their magnitude, severity, reservoir water surface elevation and other circumstances.

e. Foundation Failure

Failure of the foundation underlying either the concrete control structure or an earth embankment could occur. This could result in breaching of the dam and control structure or perimeter dike, allowing a sudden release of a large volume of water. The potential for control of foundation failure problems depends on the magnitude of the failure, the reservoir water surface elevation, and other circumstances. Continued siltation at the upstream toe of the dam and spillway also contributes to excess foundation pressure, which can

cause failure.

7. Spillway Design Flood

Pine River Dam was constructed before development of current SDF (spillway design flood) standards. The SDF for Pine River was developed from the SPF (standard project flood) series. The SPF series was obtained from the SPS (standard project storm) applied to this area added to daily flows from the 1950 flood. The resulting peak inflow, pool elevation, and outflow for the SDF were 12,250 cfs (cubic feet per second), elevation 1234.32 feet, and 6,400 cfs, respectively.

8. Existing Spillway Capacity

The design spillway capacity of Pine River Dam is not known. Discharge capacity of the dam with the slide gates fully open and only six stop logs in place in the sluiceways has been calculated. The computed discharge at the maximum operating limit (elevation 1231.32 feet) under these conditions is 4,400 cfs. A rating curve describing the existing spillway discharge is on plate 5.

9. Computation of Outflow Hydrographs

Outflow hydrographs were computed for hypothetical cases of PMF without and with failure, the 70% of PMF flood, and the threshold flood. The threshold flood is the flood that fully uses the capacity of the reservoir and allows adequate freeboard at the dam. The threshold flood is equivalent to 39 percent of the PMF. Failure at normal high pool was also investigated. Formation of a breach during the 70% of PMF flood and threshold floods was assumed to result from piping. Failure during the PMF was assumed to be caused by overtopping of the embankment. These seven conditions encompass the types of situations potentially resulting from causes of failures described in paragraph 6.

a. Computational Procedures

All outflow hydrographs were computed using the U.S. Army Corps of Engineers' HEC-1 model. Table 3 describes the principal parameters of the respective computations for the cases investigated.

b. Inflow, Outflow, and Reservoir Stage Hydrographs

The inflow, outflow, and reservoir stage hydrographs for Pine River Dam for the emergency situations of PMF without and with failure are on plates 7 and 8. The inflow, outflow, and reservoir stage hydrographs for the 70% percent of PMF flood without and with failure and for the threshold flood with and without failure are on plates 9, 10, 11 and 12.

Table 3 - Information on computation of outflow hydrographs

Condition	Probable Maximum Flood (PMF) Without Failure	Probable Maximum Flood (PMF) With Failure	Normal High* Pool With Failure	Threshold Flood Without Failure	Threshold With Failure	70% PMF Without Failure	70% PMF With Failure
Initial Pool Elevation (ft.)	1230.0	1230.0	1231.3	1230.0	1230.0	1230.0	1230.0
Inflow Hydrograph	36,800	36,800	NA	14,300	14,300	25,700	25,700
Breach Type	NA	Overtopping	Piping	NA	Piping	NA	Piping
Pool Elevation when Failure Begins (ft.)	NA	1236.3	1231.3	NA	1235.6	NA	1236.3
Maximum Pool Elevation (ft.)	1241.9	1240.1	1231.3	1235.7	1235.6	1238.4	1237.1
Maximum Release Rate (cfs)	18,300	22,500	4,200	5,500	15,300	12,200	17,200
Ultimate Bottom Width of Breach (ft.)	NA	60	60	NA	60	NA	60
Side Slope of Breach (units horizontal to 1 unit vertical)	NA	0	0	NA	0	NA	0
Time for Breach to Develop (hrs)	NA	1.5	1.5	NA	1.5	NA	1.5

*Maximum release rate is documented. The remaining data are unavailable. Data assumed.

c. Maximum Pool Elevations

The computed maximum pool elevations resulting from PMF without and with failure are 1241.9 feet and 1240.1 feet. The computed maximum pool elevations given respectively without and with failure for the 70% of PMF floods are 1238.4 feet and 1237.1 feet and for the threshold flood are 1235.7 feet and 1235.6 feet.

d. Comparison of Computed Peak Outflows

The adopted PMF has a peak inflow of 36,800 cfs. The computed maximum peak outflow for the cases of PMF with failure is 22,500 cfs. The hydraulic depth of the Pine River Dam from the PMF level to the invert of the outlet is approximately 23.5 feet. Plate 16 gives an envelope curve of experienced outflow rates from breached dams. The envelope curve can be described by the following equation:

$$Q_B = 75(D)^{1.85}$$

where Q_B is the outflow in cfs and D is the hydraulic depth in feet.

The value of the envelope curve for a hydraulic depth of 23.5 feet is 25,800 cfs, which is 3,300 cfs greater than the maximum outflow computed for the Pine River Dam. The computed results for the PMF with failure lie within the historical envelope for outflow rates from breached dams.

10. Routing of Outflow Hydrographs

The downstream impacts resulting from floodplain inundation along Pine River were evaluated at maximum elevations reached for each flood. The dam outflow hydrographs for each of the hypothetical flood and breach events were routed through Pine River channel using the HEC-1 computer model, and downstream elevations were taken from these hydrographs. Topographical features of the river channel and floodplain were determined using USGS (U.S. Geological Survey) quadrangle maps and field notes and were incorporated into the routing model. Discharge hydrographs simulated for the various floods at Pine River Reservoir were routed through nine reaches, a distance of 16 miles downstream, to the confluence of the Pine and Mississippi Rivers. Typical cross sections were chosen to represent each reach unless a nontypical narrowing of the river showed a potential for increasing water level. In such cases, a narrow channel cross section was used to model the influence of backwater effects on water surface elevations. Reach 3 of the flood routing model represents the storage areas, including Big Pine Lake and Greer Lake, which will be affected by Pine River water levels.

Table 4 - Downstream water surface elevations

Reach number	Miles downstream from dam	Normal* highpool with dam failure	Threshold flood (39% PMF) Without dam failure	Threshold flood (39% PMF) With dam failure	(70% PMF) Without dam failure	(70% PMF) With dam failure	(PMF) Without dam failure	(PMF) With dam failure
1	0.9	1220	1224.5	1234.9	1230.6	1236.8	1235.3	1237.7
2	2.2	1216	1218.5	1230.2	1225.4	1232.7	1231.0	1234.2
3	3.3	1208	1212.8	1220.0	1221.3	1224.6	1225.3	1228.0
4	4.7	1205	1207.5	1213.4	1213.4	1216.3	1217.0	1219.0
5	6.5	1200	1204.0	1212.2	1210.3	1214.0	1214.8	1217.3
6	8.4	1197	1200.5	1206.9	1206.4	1209.7	1210.5	1212.8
7	10.3	1193	1197.3	1205.1	1204.5	1208.4	1209.2	1211.8
8	13.2	1188	1192.2	1198.9	1198.6	1202.1	1202.9	1205.3
9	16.0	1182	1186.6	1195.9	1195.5	1200.1	1201.0	1204.1

*Note elevations read from plate C-2 of reference 25 to the nearest foot. Normal high pool elevation is 1231.3 feet.

Peak discharges from the dam are limited by backwater effects caused by the County Highway 3 bridge and its embankment and the flat terrain in the vicinity of the river. The impact dam failure has on large floods is lessened because of the tail-water control of these events. Downstream water surface elevations for the cases of without and with dam failure vary as much as 11.7 feet for the threshold flood, 7.3 feet for the 70% of PMF flood, and 3.2 feet for the PMF. Maximum water surface elevations in downstream reaches for the flood routings are in table 4. Pine River crest profiles for the PMF and high pool with failure, 70% of PMF, and threshold floods are on plates 13, 14, and 15. These profiles show that, for the threshold flood, there is a significant increase in water surface elevation with a dam failure because less water is in the downstream channel at the time failure occurs, reducing tail-water effects. Plates D-2 and D-3 show the area inundated by the PMF. Hazardous conditions exist when (1) floodwater depths are greater than 2 feet, (2) floodwater velocities exceed 4 feet per second, and (3) floodwater depths are sufficient to damage property.

11. Inundation Maps

An inundation map package is included in appendix D. The boundaries of the areas expected to be inundated by the hypothesized conditions of PMF without failure and PMF with failure are shown on plates D-2 and D-3.

12. Affected Areas

The Pine River Dam reconnaissance report (reference 27) states that the peak discharge for the PMF (without dam breach) is 18,300 cfs, which is about 14,000 cfs greater than the spillway capacity at the maximum operating limit. The peak reservoir pool level during the PMF is elevation 1241.9 feet, which is as much as 4.6 feet over the embankment. This report also indicates that a dam breach, in conjunction with a PMF, would increase the degree of flooding downstream.

The computed peak discharge for a dam failure at normal high pool is 4,200 cfs. The increased flow velocities and/or waves caused by such a sudden release of a large volume of water would present a hazard to life and property in the vicinity of the dam at the time of failure and adjacent to Pine River as the flood crest moved downstream.

13. Identification of Needed Evacuation Planning

a. Jurisdictions Affected Downstream of Pine River Dam

The area affected could encompasses parts of the following jurisdictions:

(1) Crow Wing County.

(2) Cross Lake.

(3) Brainerd.

(4) Cross Lake Township.

(5) Mission Township.

b. Evacuation Plans

Plans pertinent to the dissemination of flood warnings and evacuation in the portions of the jurisdictions that would be affected in the case of a flood with or without failure or failure at normal pool should incorporate the information presented in this report into all existing and future plans. A copy of this report is to be provided to the appropriate emergency personnel for each of the affected communities.

c. Evaluation of Evacuation Plans

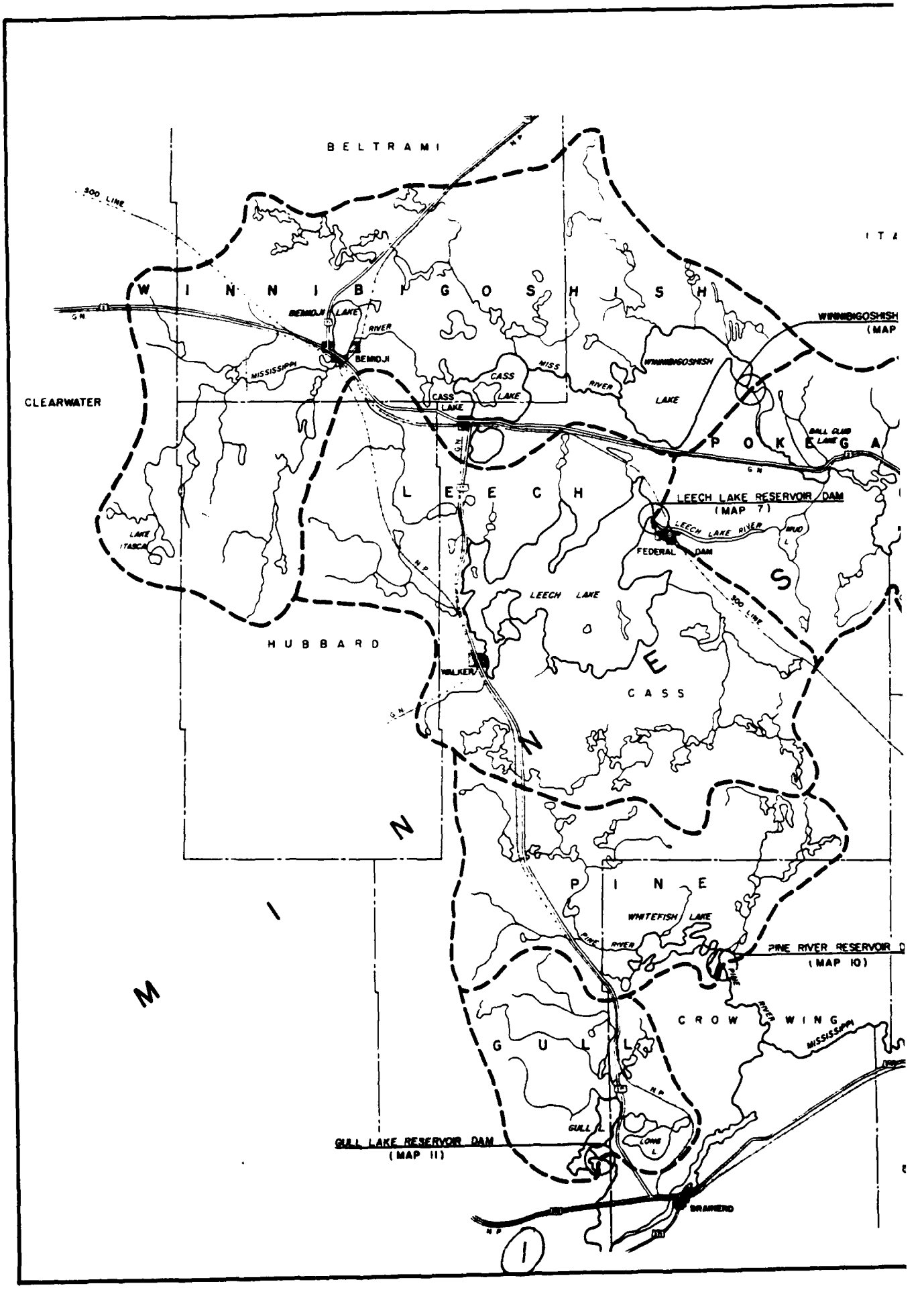
Principal characteristics of evacuation plans that affect their potential for successful execution are given in table 5.

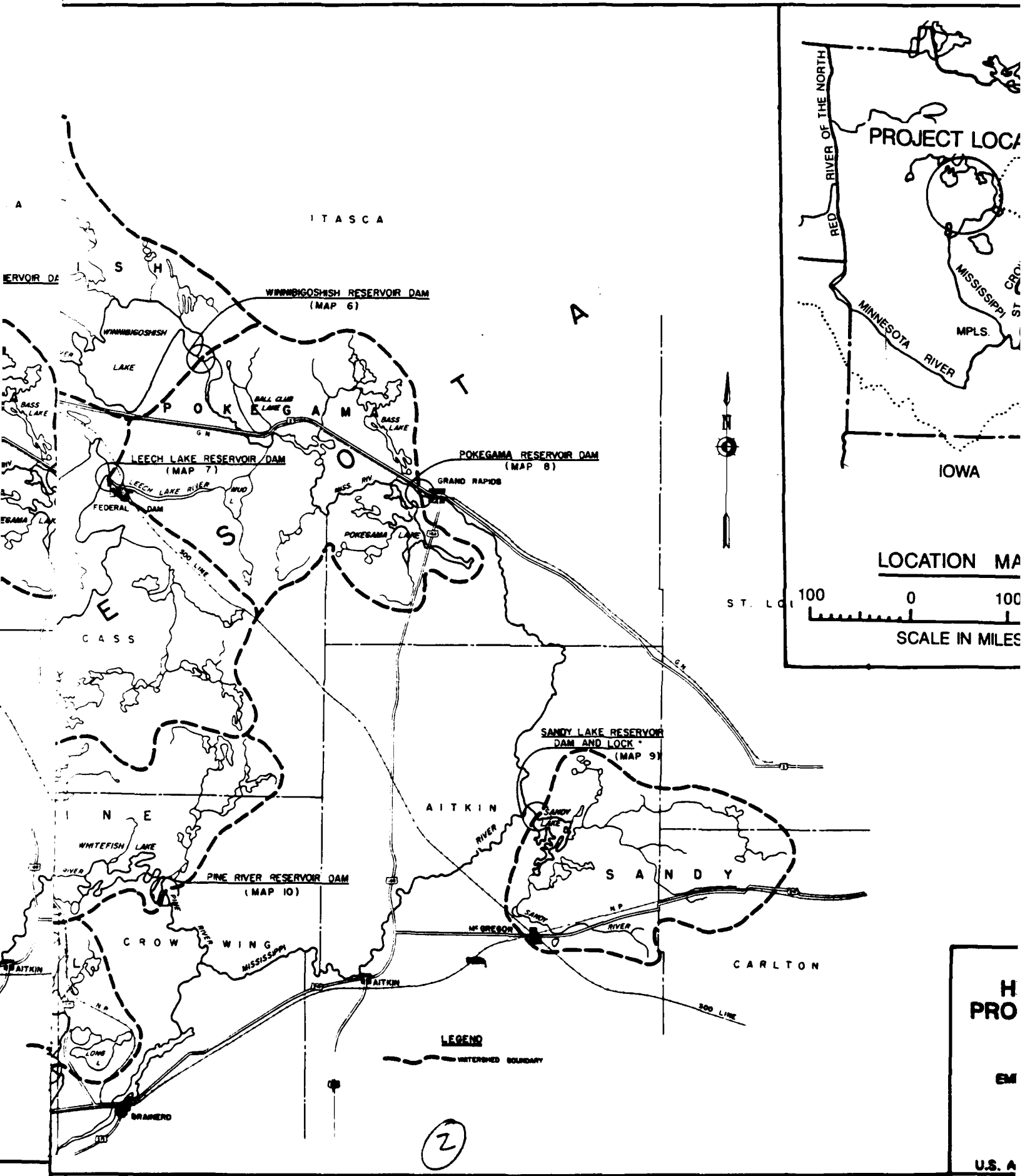
d. Evacuation Planning

Evacuation plans are to be developed through local coordination with the affected communities. Information on evacuation planning and examples of evacuation plans are available from the Corps of Engineers. See appendix D for areas to be considered for evacuation.

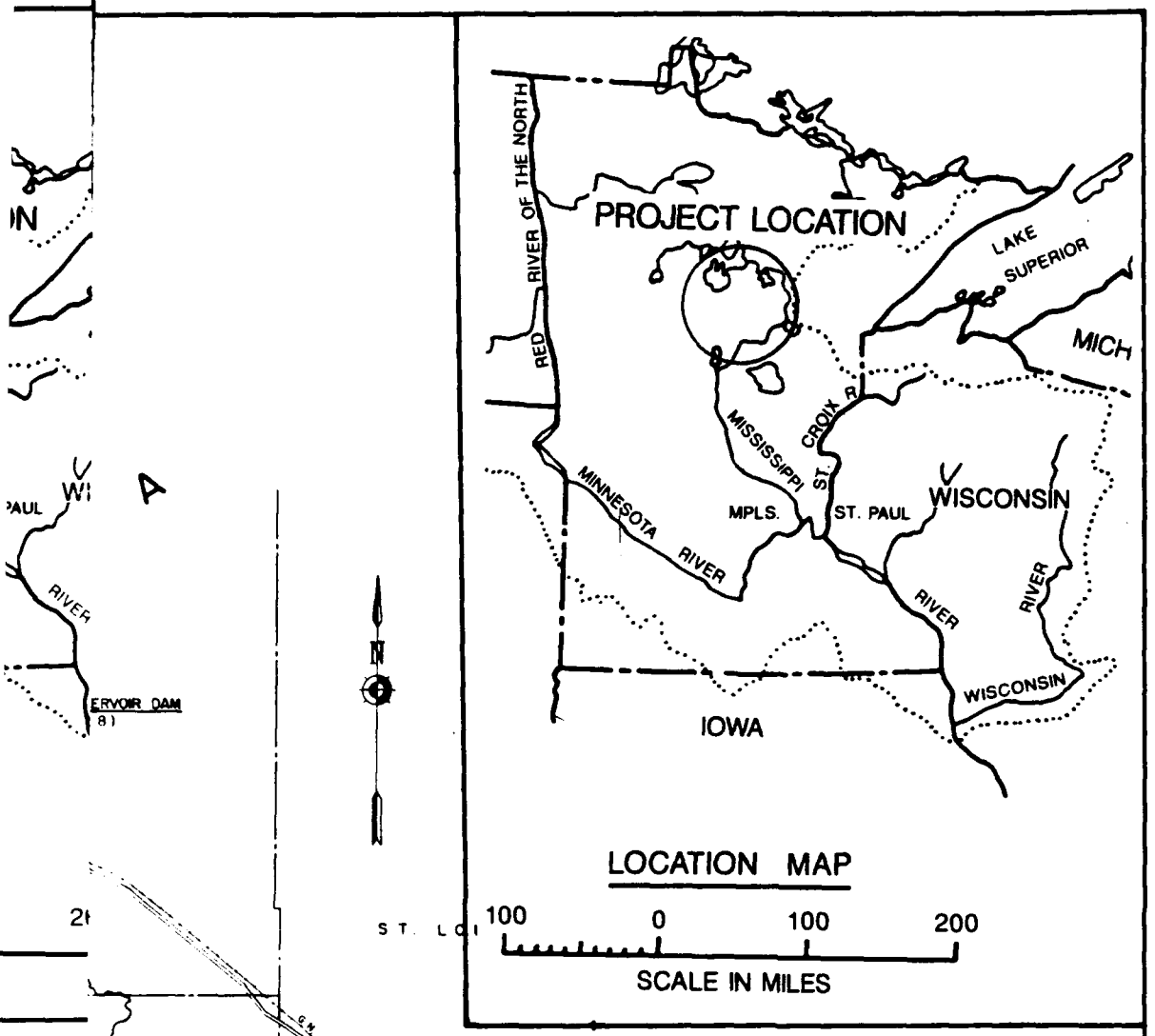
Table 5 - Characteristics of evacuation plans

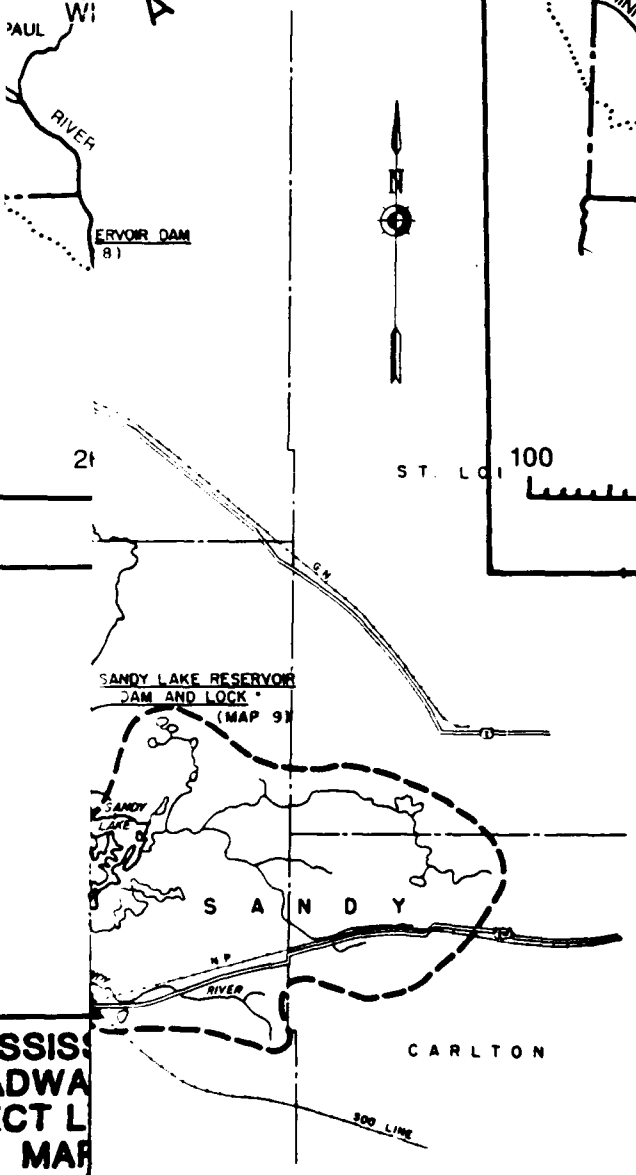
Characteristic	Plan 1	Plan 2	Plan 3
Is plan written?			
Is plan current?			
Does plan have legal status through appropriate adoption or recognition by non-Federal authorities?			
Does plan specify actions to be taken in sufficient detail to avoid indecision on whether to execute the plan and how it should be executed?	**EVACUATION PLANS AREA ARE A LOCAL RESPONSIBILITY**		
Does plan make specific assignments of responsibility for its initiation and execution?			
Does plan cover all parts of the jurisdiction requiring evacuation?			
Is successful execution of the plan in potential emergency situations reasonable in view of the warning time likely to be available for an emergency?			
Is plan consistent with various causes of emergencies likely to exist at time evacuation is required?			
Does plan evidence realistic analysis of means of warning and transporting evacuees, lane capacities of escape routes, and other pertinent matters?			
Are equipment, personnel, and materials required for execution of the plan identified?			
Does plan contain adequate provisions for updating, testing, practice, and other maintenance activities to ensure its continued viability?			


BELTRAMI
500 LINE
WINNIBIGOSHISH
CLEARWATER
BEMIDJI LAKE
BEMIDJI
MISSISSIPPI
RIVER
CASS LAKE
CASS LAKE
WISS RIVER
WINNIBIGOSHISH LAKE
WINNIBIGOSHISH (MAP
POKEGA
BALL CLUB LAKE
LEECH
LEECH LAKE RESERVOIR DAM (MAP 7)
LEECH LAKE RIVER
FEDERAL DAM
LAKE ITASCA
LEECH LAKE
HUBBARD
WALKER
CASS
PINE
WHITEFISH LAKE
PINE RIVER
PINE RIVER RESERVOIR (MAP 10)
CROW WING
MISSISSIPPI
GULL
GULL LAKE RESERVOIR DAM (MAP 11)
GULL L.
LOWS L.
BRAINERD
GN
NP


ITASCA
WINNIBIGOSHISH RESERVOIR DAM
(MAP 6)
WINNIBIGOSHISH LAKE
POKEGAMA
LEECH LAKE RESERVOIR DAM
(MAP 7)
LEECH LAKE RIVER
FEDERAL DAM
POKEGAMA RESERVOIR DAM
(MAP 8)
GRAND RAPIDS
POKEGAMA LAKE
CASS
SANDY LAKE RESERVOIR
DAM AND LOCK
(MAP 9)
AITKIN
SANDY LAKE
SANDY
RIVER
WHITEFISH LAKE
PINE RIVER RESERVOIR DAM
(MAP 10)
CROW WING
MISSISSIPPI
MC GREGOR
CARLTON
AITKIN
BRAINERD
LONG L.
300 LINE
GN
NP
LEGEND
WATERSHED BOUNDARY
N
PROJECT LOCA
RED
RIVER OF THE NORTH
MISSISSIPPI
MINNESOTA
RIVER
MPLS.
IOWA
LOCATION MA
100
0
100
SCALE IN MILES

(2)



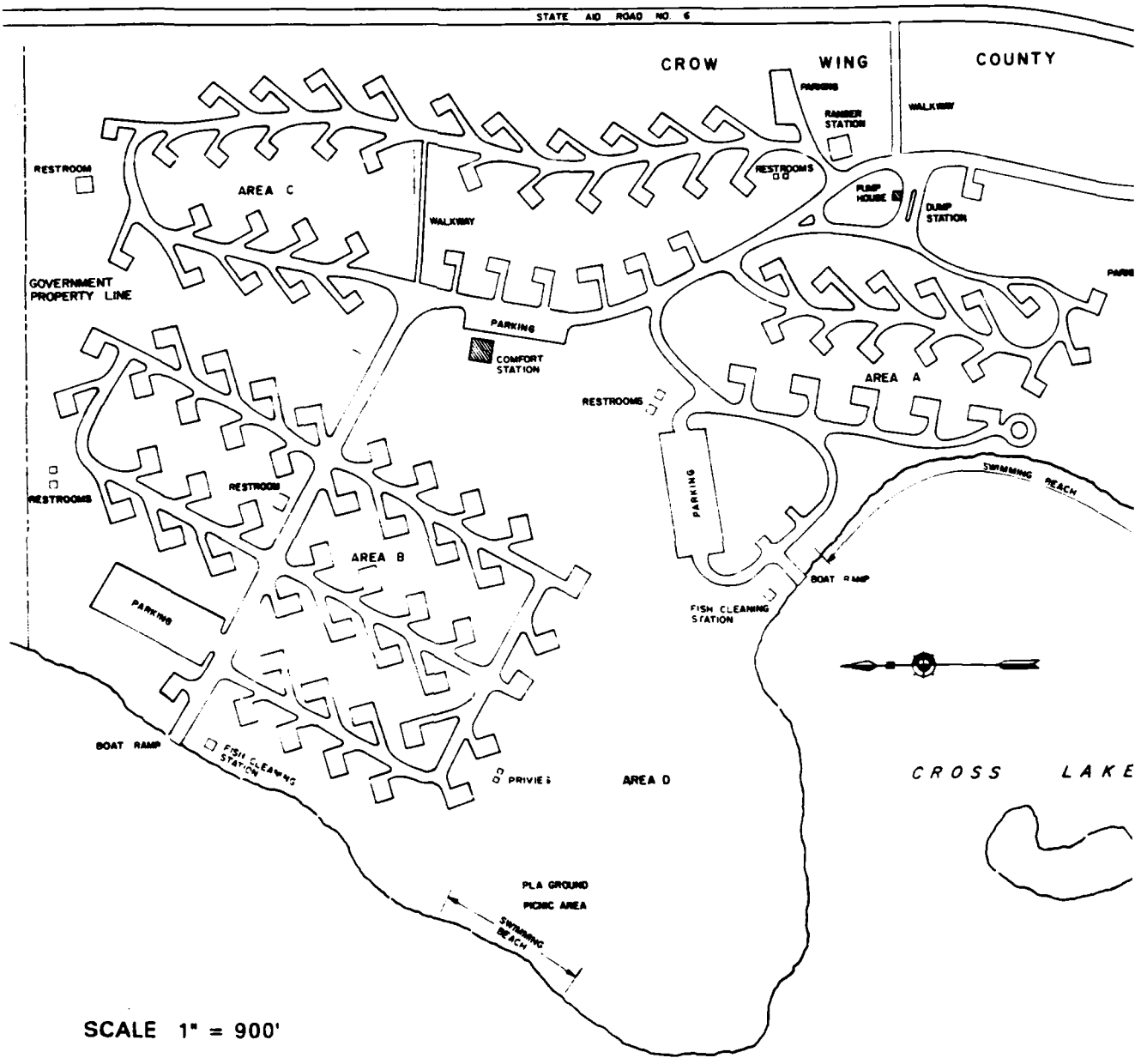


MISSISSIPPI HEADWATERS PROJECT LOCATION MAP

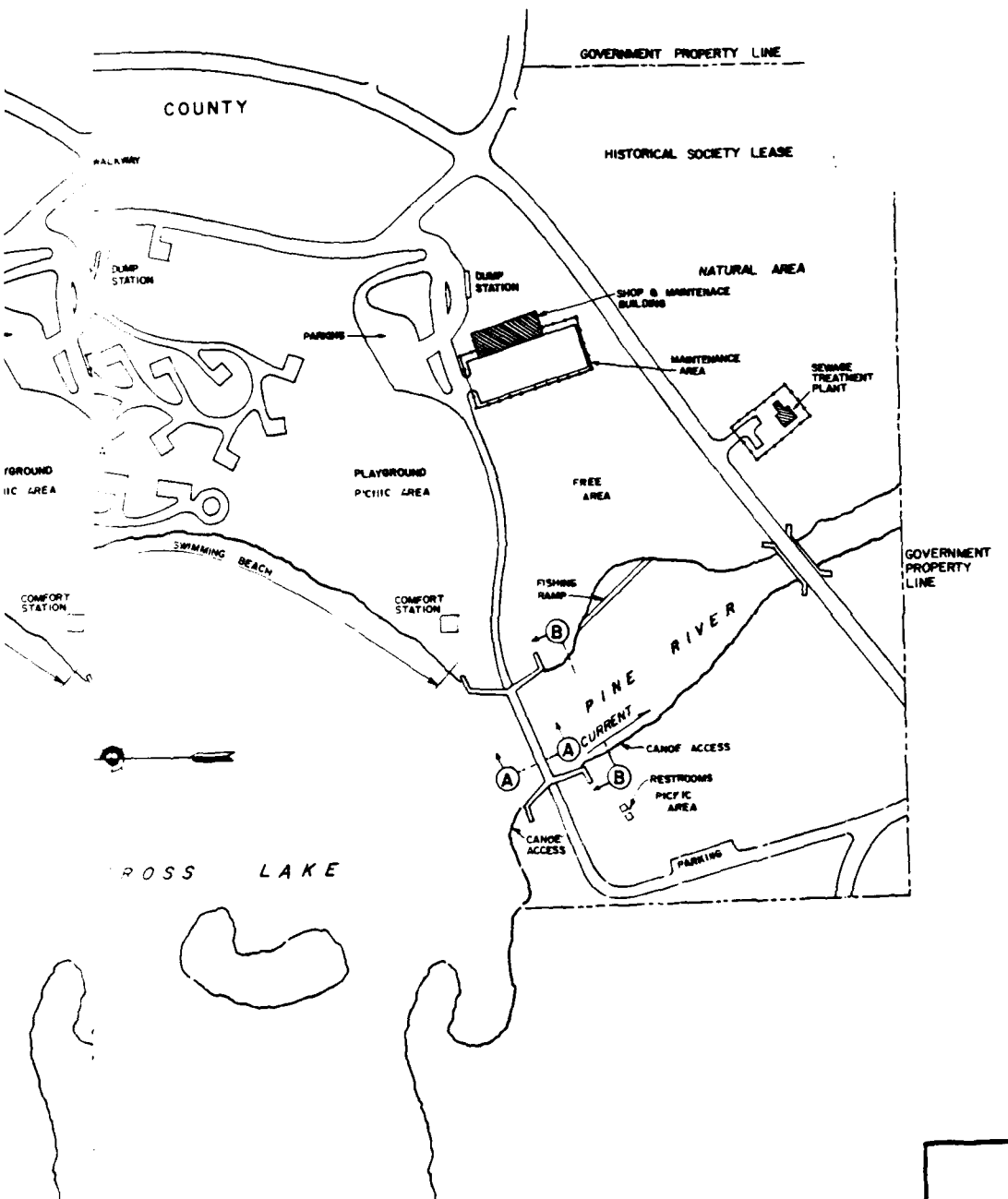
EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

(3)

PLATE 1


STATE AID ROAD NO. 6
CROW WING COUNTY
RESTROOM
AREA C
WALKWAY
RANGER STATION
RESTROOMS
PUMP HOUSE
DUMP STATION
GOVERNMENT PROPERTY LINE
PARKING
COMFORT STATION
AREA A
RESTROOMS
RESTROOMS
RESTROOM
AREA B
PARKING
PARKING
SWIMMING BEACH
BOAT RAMP
FISH CLEANING STATION
BOAT RAMP
FISH CLEANING STATION
PRIVIES
AREA D
CROSS LAKE
PLA GROUND
PICNIC AREA
SWIMMING BEACH

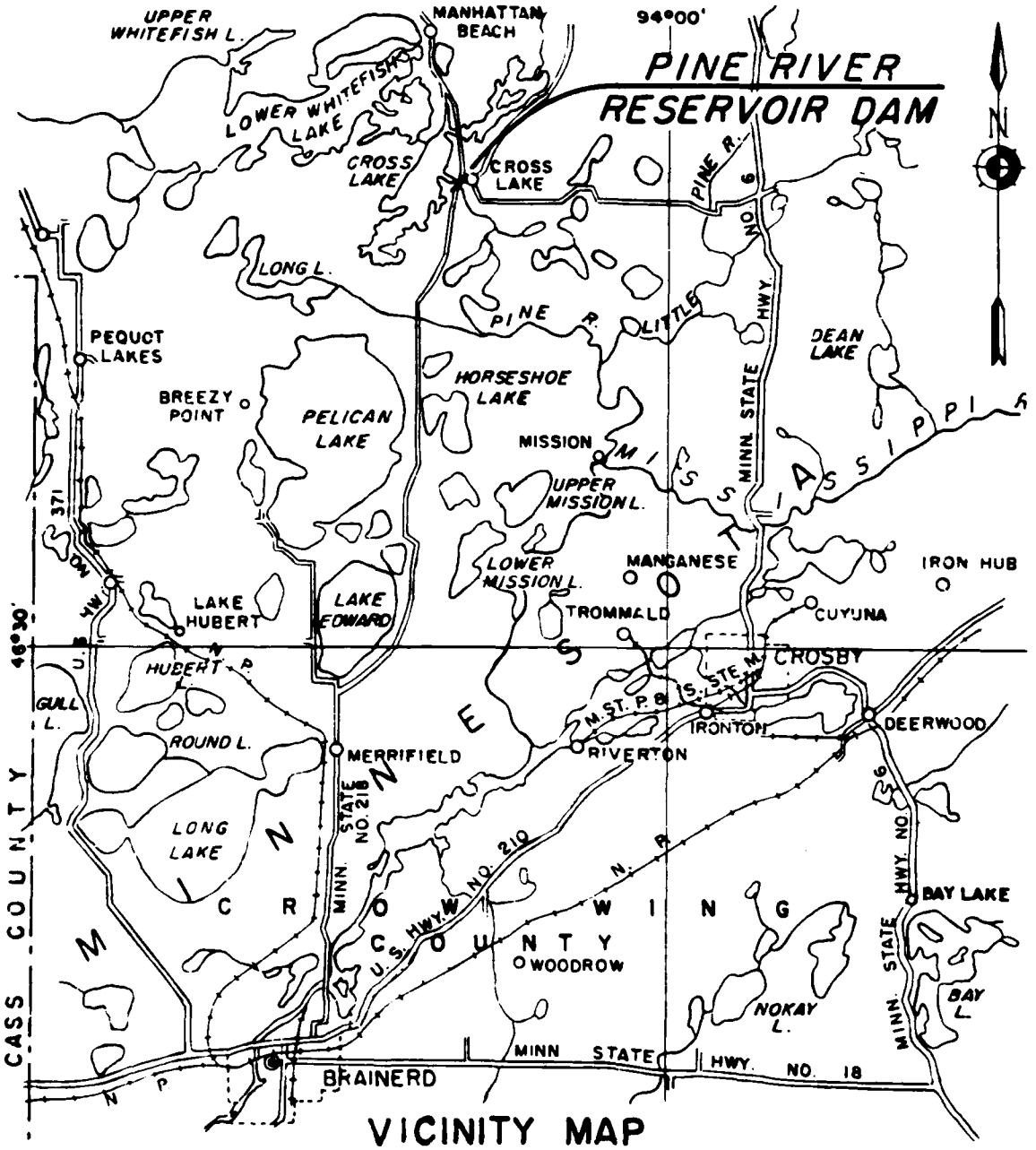
SCALE 1" = 900'



PROJECT FEATURES MAP

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE 2



VICINITY MAP

4 0 4 8

SCALE IN MILES

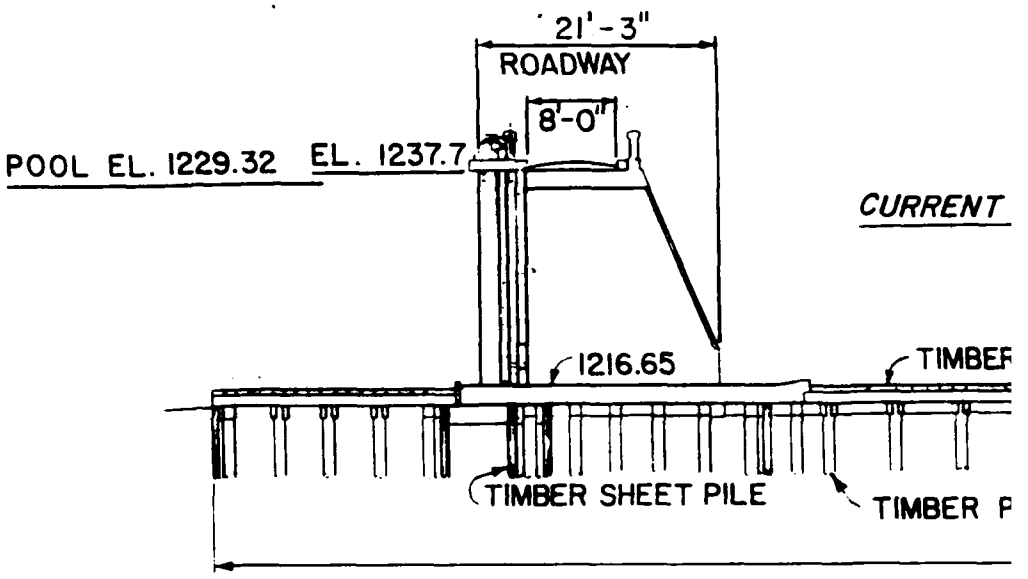
(1)

PROJECT MAP

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

(2)

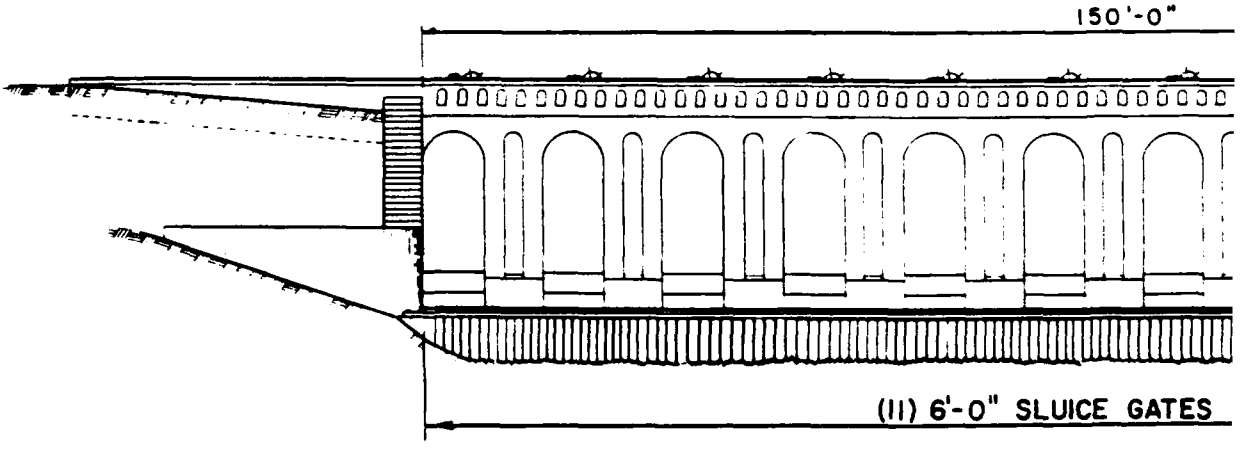
PLATE 2A



SECTION A-A

10 0 10 20 30

SCALE IN FEET

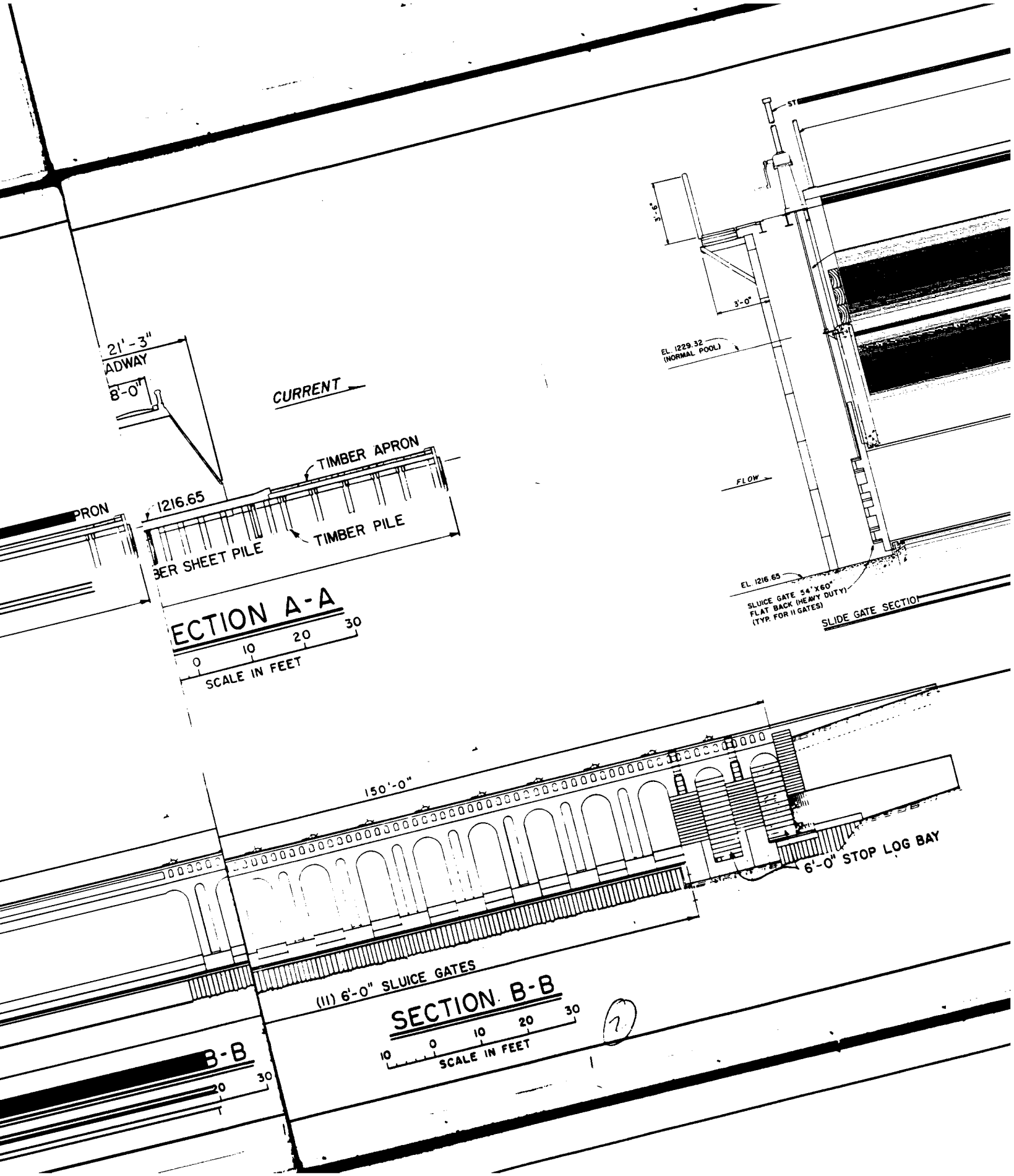


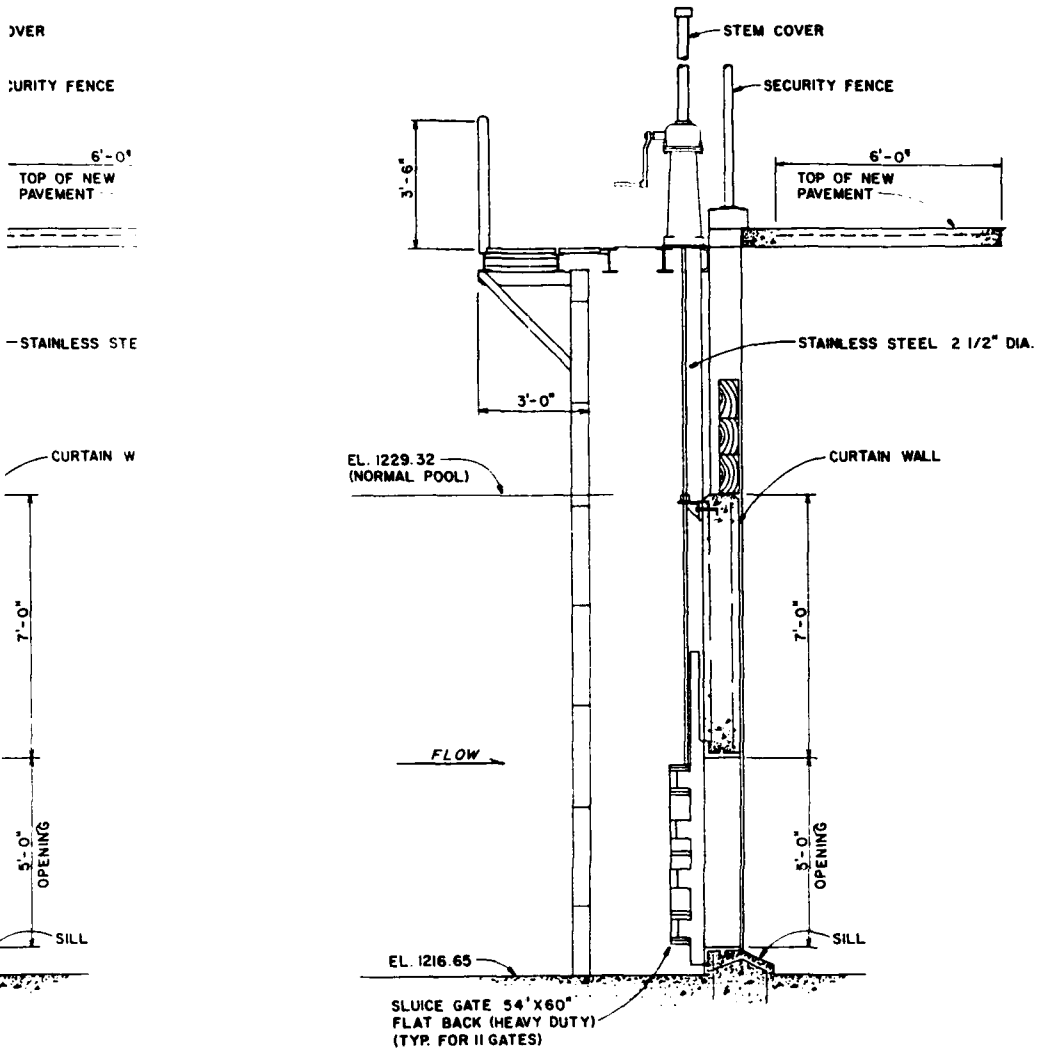
SECTION

10 0 10

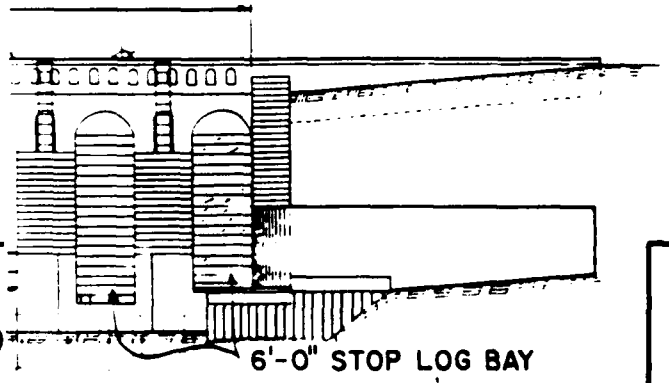
SCALE IN F

(1)


21'-3"
ADWAY
8'-0"
CURRENT
TIMBER APRON
1216.65
TIMBER PILE
3ER SHEET PILE
PRON
ECTION A-A
0 10 20 30
SCALE IN FEET
3'-6"
3'-0"
EL 1229.32
(NORMAL POOL)
FLOW
EL 1216.65
SLUICE GATE 54"X60"
FLAT BACK (HEAVY DUTY)
(TYP. FOR 11 GATES)
SLIDE GATE SECTIO
150'-0"
6'-0" STOP LOG BAY
(11) 6'-0" SLUICE GATES
SECTION B-B
10 0 10 20 30
SCALE IN FEET
B-B
20 30



SLIDE GATE SECTION



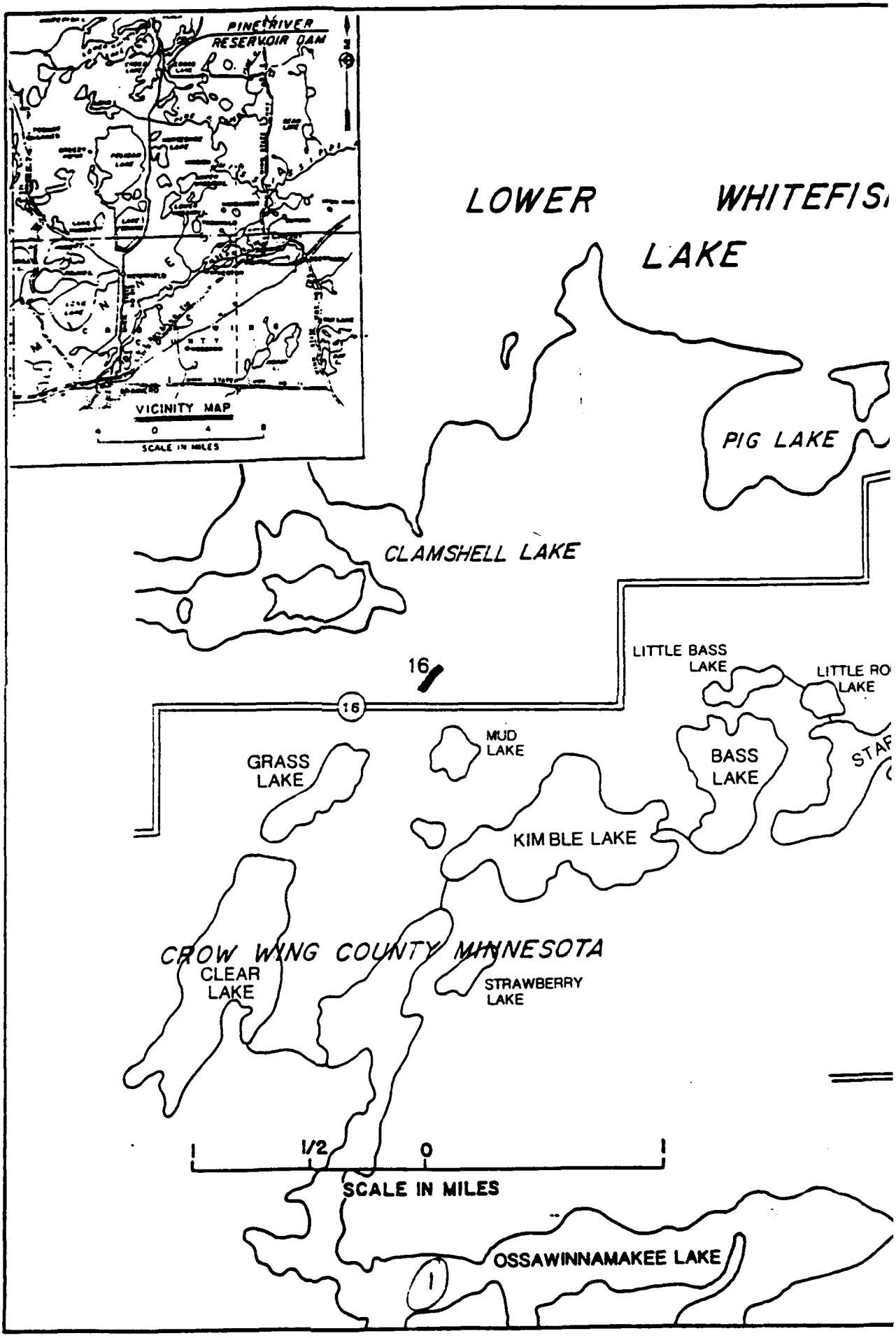
6'-0" STOP LOG BAY

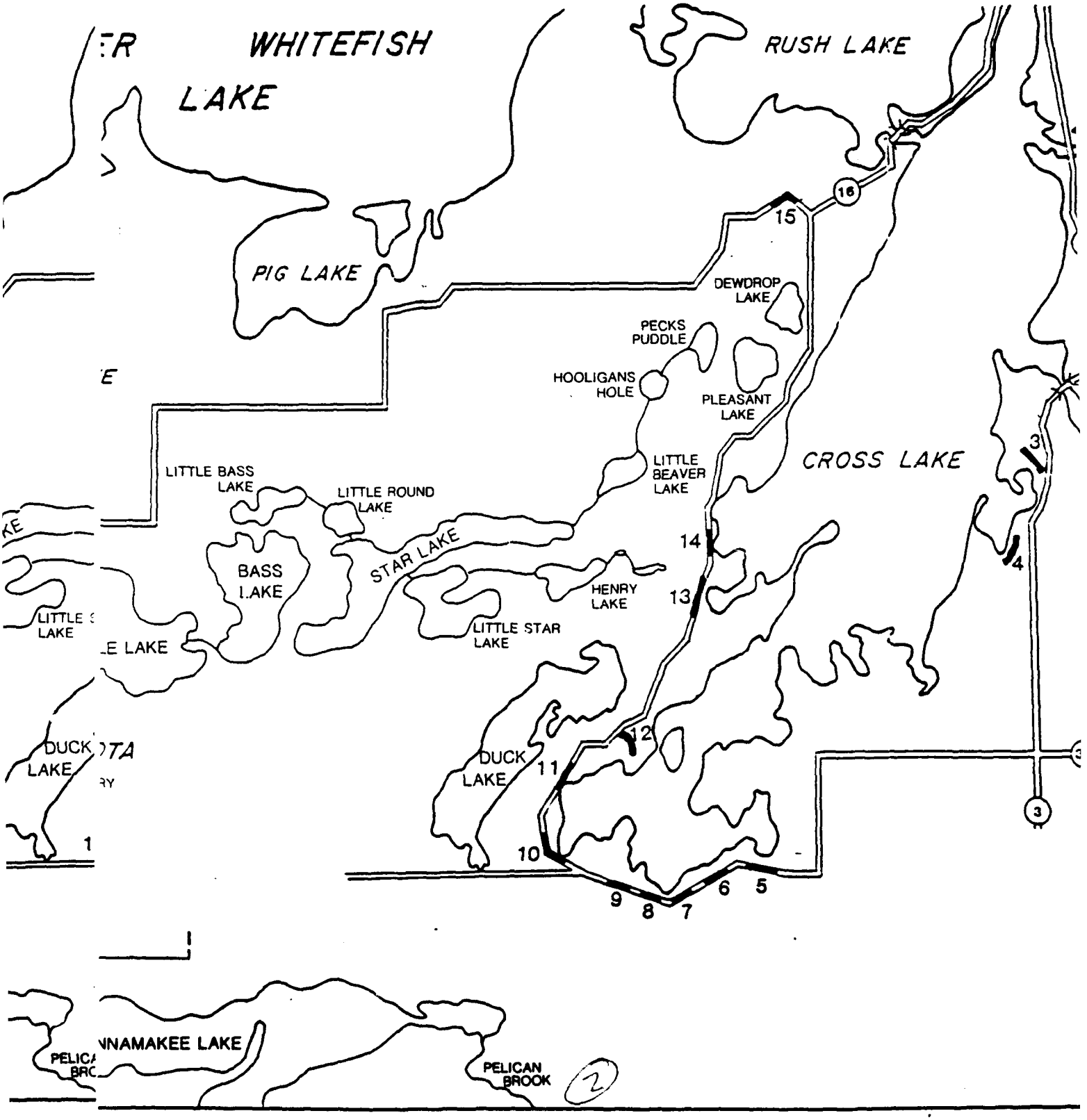
CROSS-SECTIONS

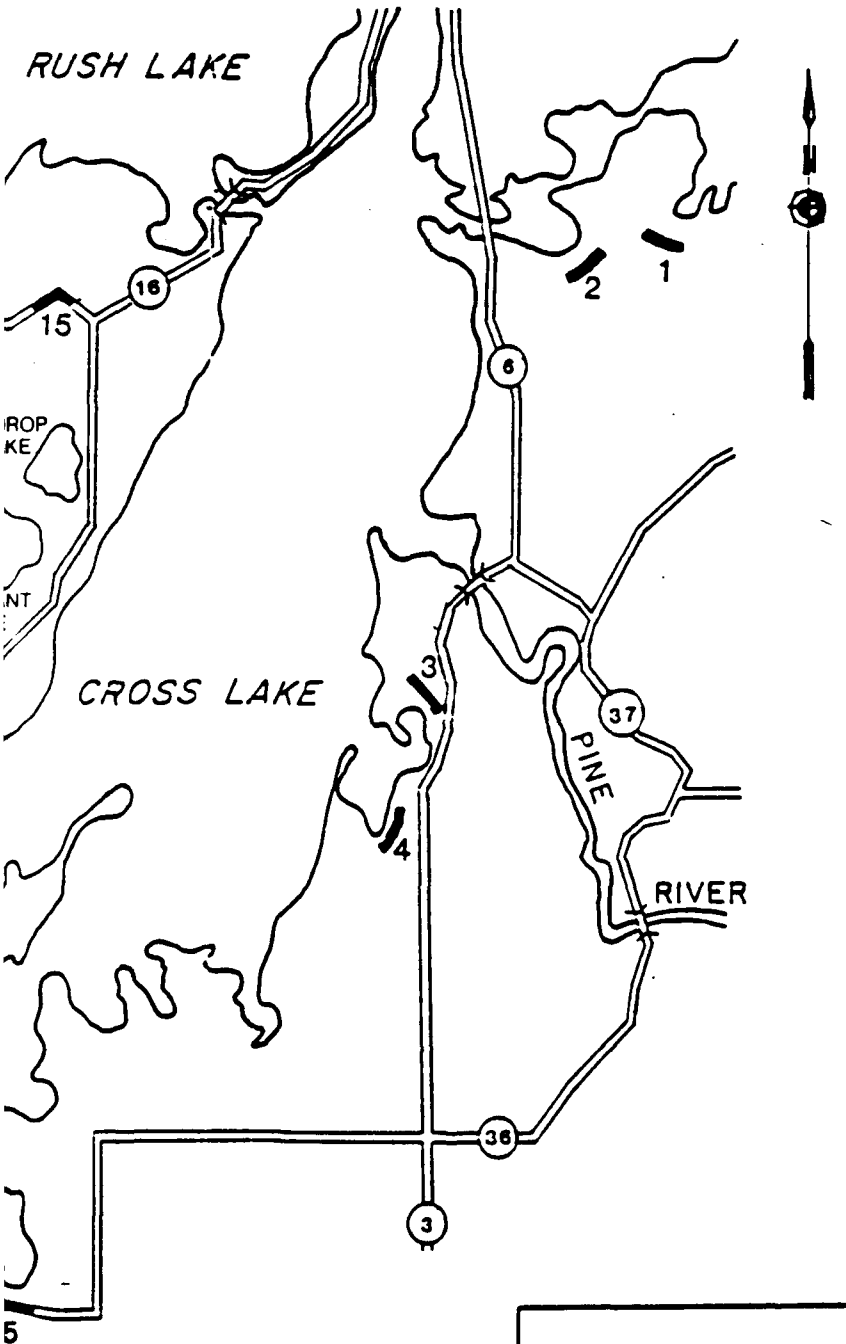
3

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE 3


PINE RIVER
RESERVOIR DAM
VICINITY MAP
0
4
SCALE IN MILES
LOWER
WHITEFISH
LAKE
PIG LAKE
CLAMSHELL LAKE
16
LITTLE BASS
LAKE
LITTLE RO
LAKE
MUD
LAKE
GRASS
LAKE
BASS
LAKE
KIMBLE LAKE
CROW WING COUNTY MINNESOTA
CLEAR
LAKE
STRAWBERRY
LAKE
1/2
0
SCALE IN MILES
OSSAWINNAMAKEE LAKE


WHITEFISH
LAKE
RUSH LAKE
PIG LAKE
DEWDROP LAKE
PECKS PUDDLE
HOOLIGANS HOLE
PLEASANT LAKE
LITTLE BASS LAKE
LITTLE ROUND LAKE
LITTLE BEAVER LAKE
CROSS LAKE
STAR LAKE
BASS LAKE
HENRY LAKE
LITTLE STAR LAKE
DUCK LAKE
PELICAN BROOK
15
16
14
13
12
11
10
9
8
7
6
5
4
3
2
1

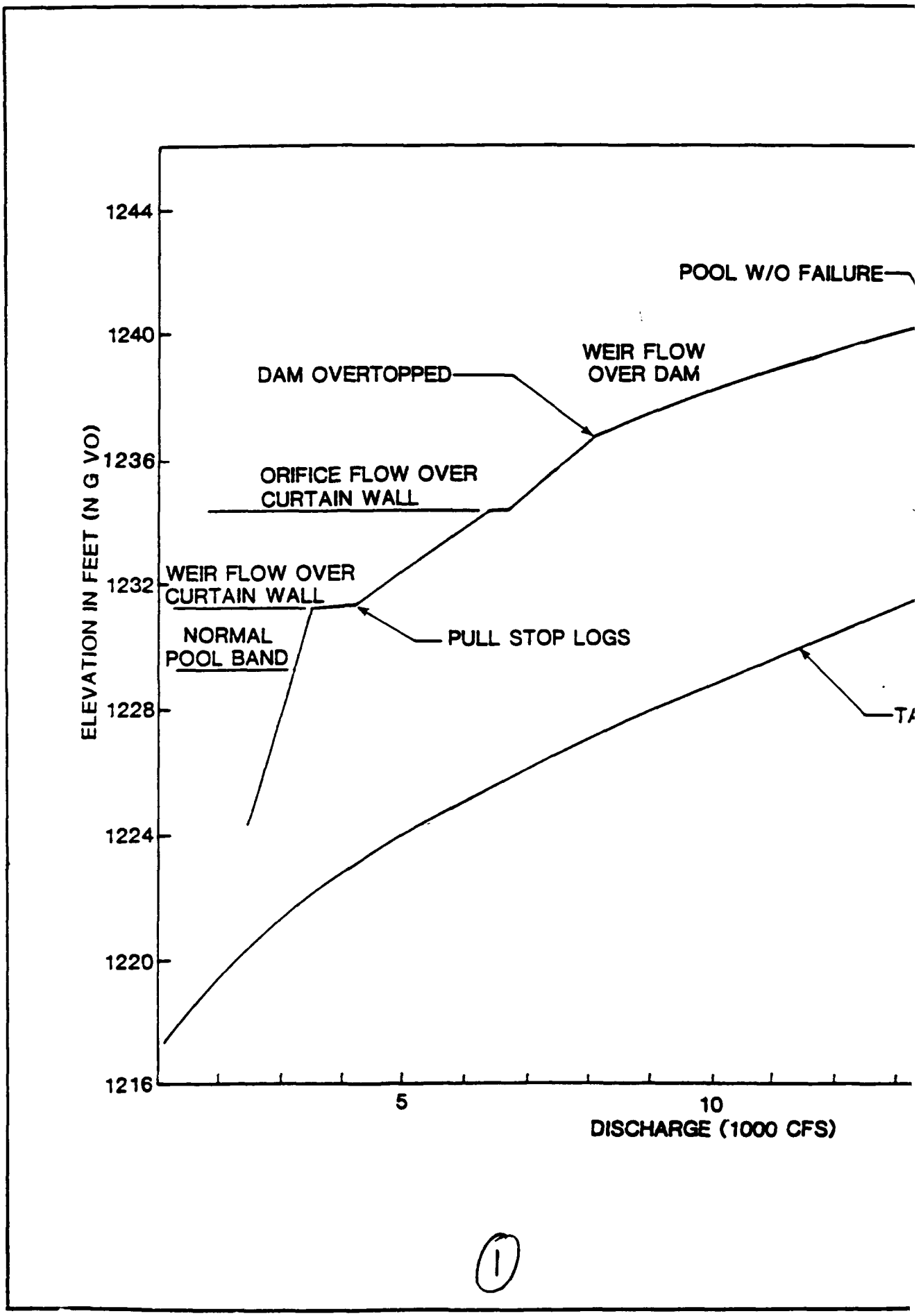


PERIMETER DIKE LOCATION MAP

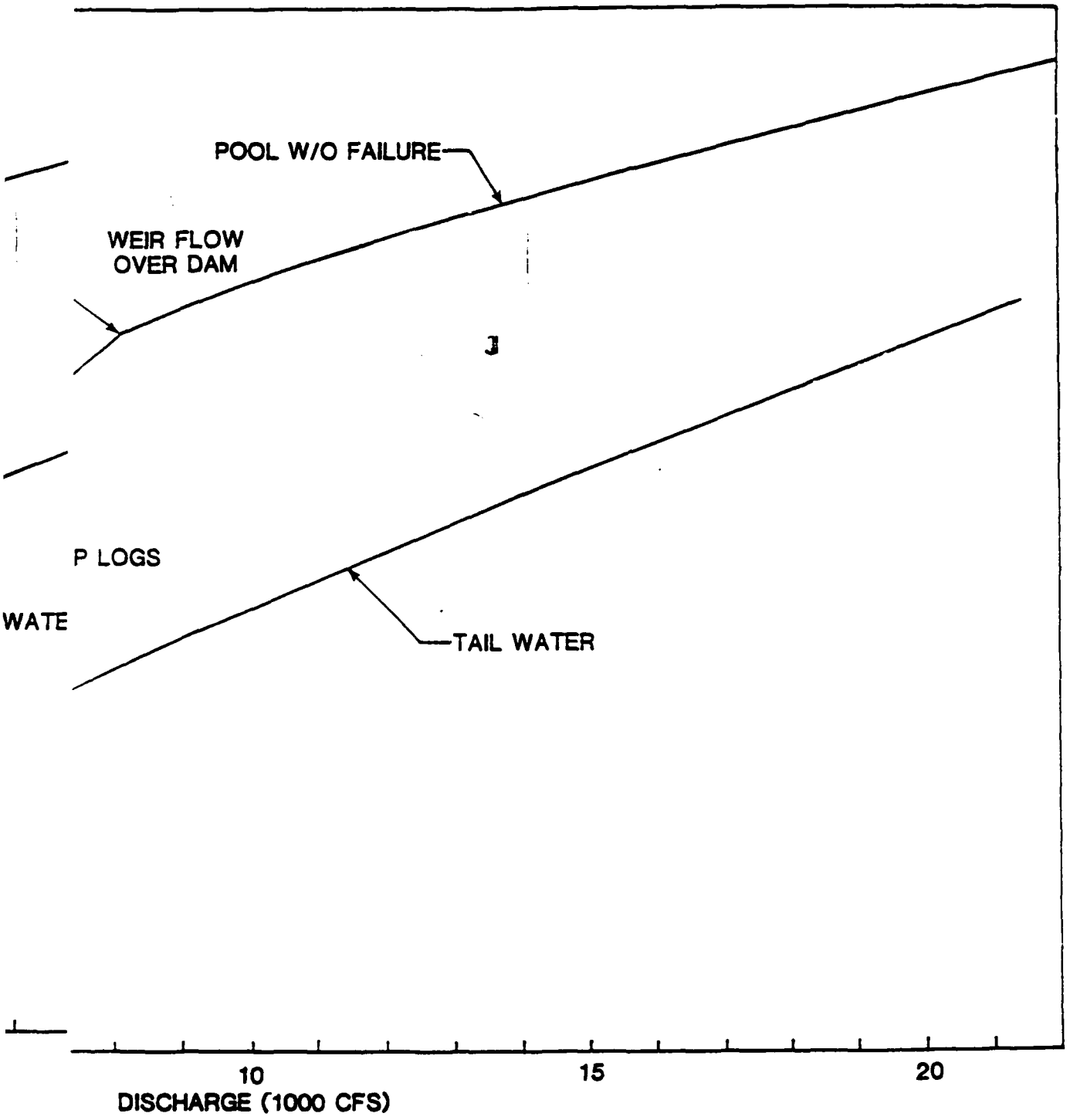
3

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

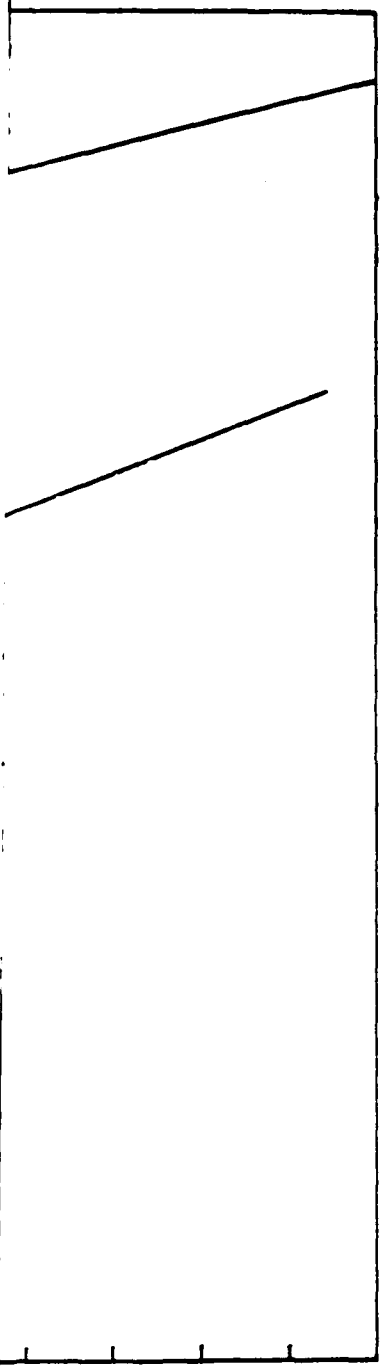
PLATE 4


1244
1240
1236
1232
1228
1224
1220
1216
ELEVATION IN FEET (N G VO)
POOL W/O FAILURE
WEIR FLOW
OVER DAM
DAM OVERTOPPED
ORIFICE FLOW OVER
CURTAIN WALL
WEIR FLOW OVER
CURTAIN WALL
NORMAL
POOL BAND
PULL STOP LOGS
TA
5
10
DISCHARGE (1000 CFS)

(1)


POOL W/O FAILURE
WEIR FLOW
OVER DAM
P LOGS
WATE
TAIL WATER
10
15
20
DISCHARGE (1000 CFS)

(2)



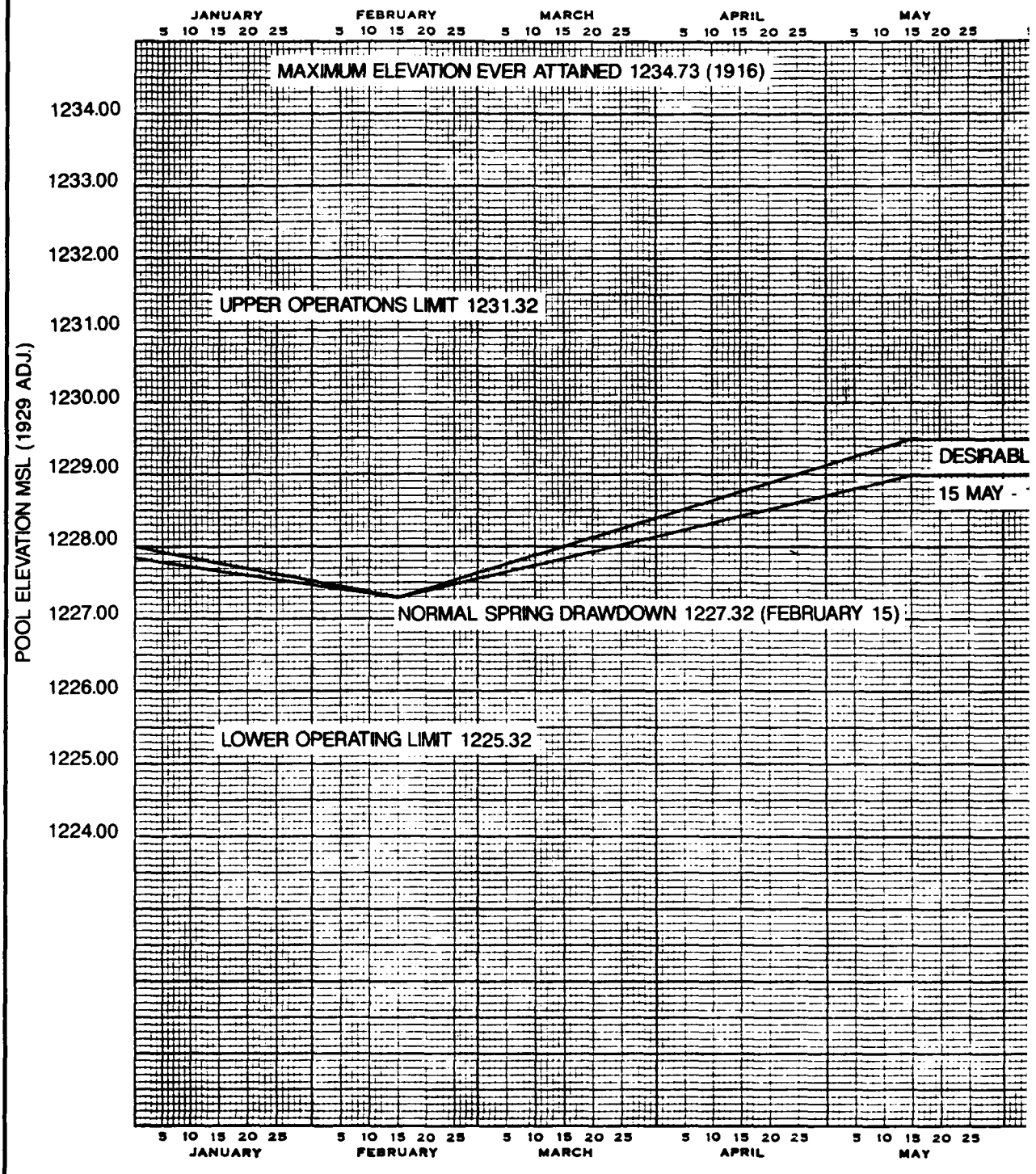
RATING CURVES

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

(3)

PLATE 5

FLOWAGE EASEMENTS TO ELEVATION 1238.82



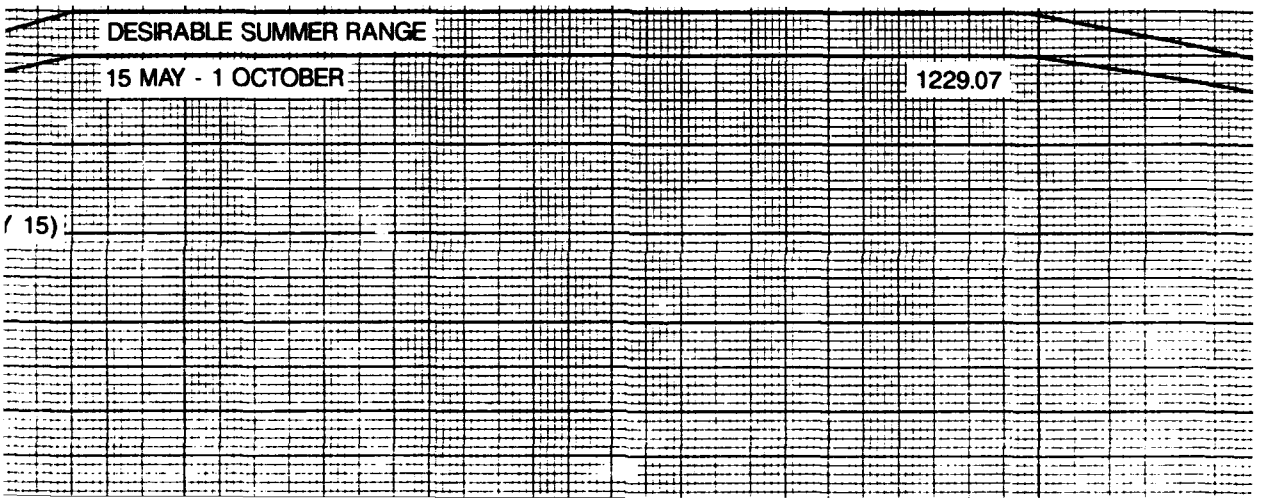
1. RELEASE RATE IS VARIABLE AND IS DEPENDENT ON DOWN STREAM CONDITIONS RESERVOIR

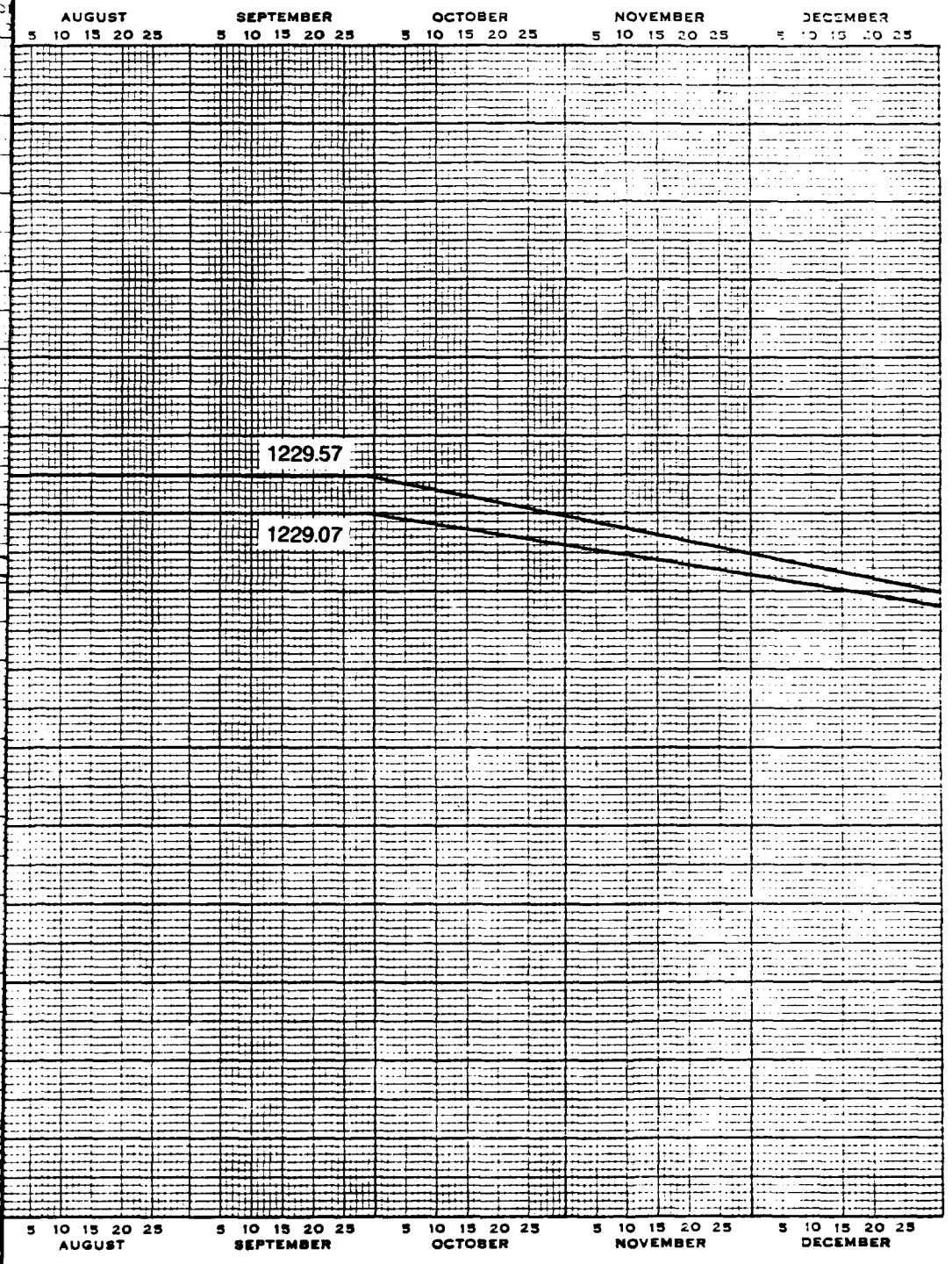
2. MINIMUM RELEASE RATE IS 30 CFS DOWN TO ELEVATION 1225.32, BELOW THAT THE RATE IS PERIODS THE MINIMUM RELEASE RATE MAY BE 90 CFS OR HIGHER AS AUTHORIZED BY THE C

3. MAXIMUM RELEASE RATE IS 2,500 CFS BETWEEN LAKE ELEVATIONS 1230.32 AND 1231.32. F THE DAM WIDE OPEN ABOVE ELEVATIONS 1231.32. FOR MAXIMUM RELEASE RATES FOR PO

4. CHANNEL CAPACITY BELOW PINE RIVER DAM IS 2,500 CFS.

(1)


DESIRABLE SUMMER RANGE
15 MAY - 1 OCTOBER
1229.07
15)



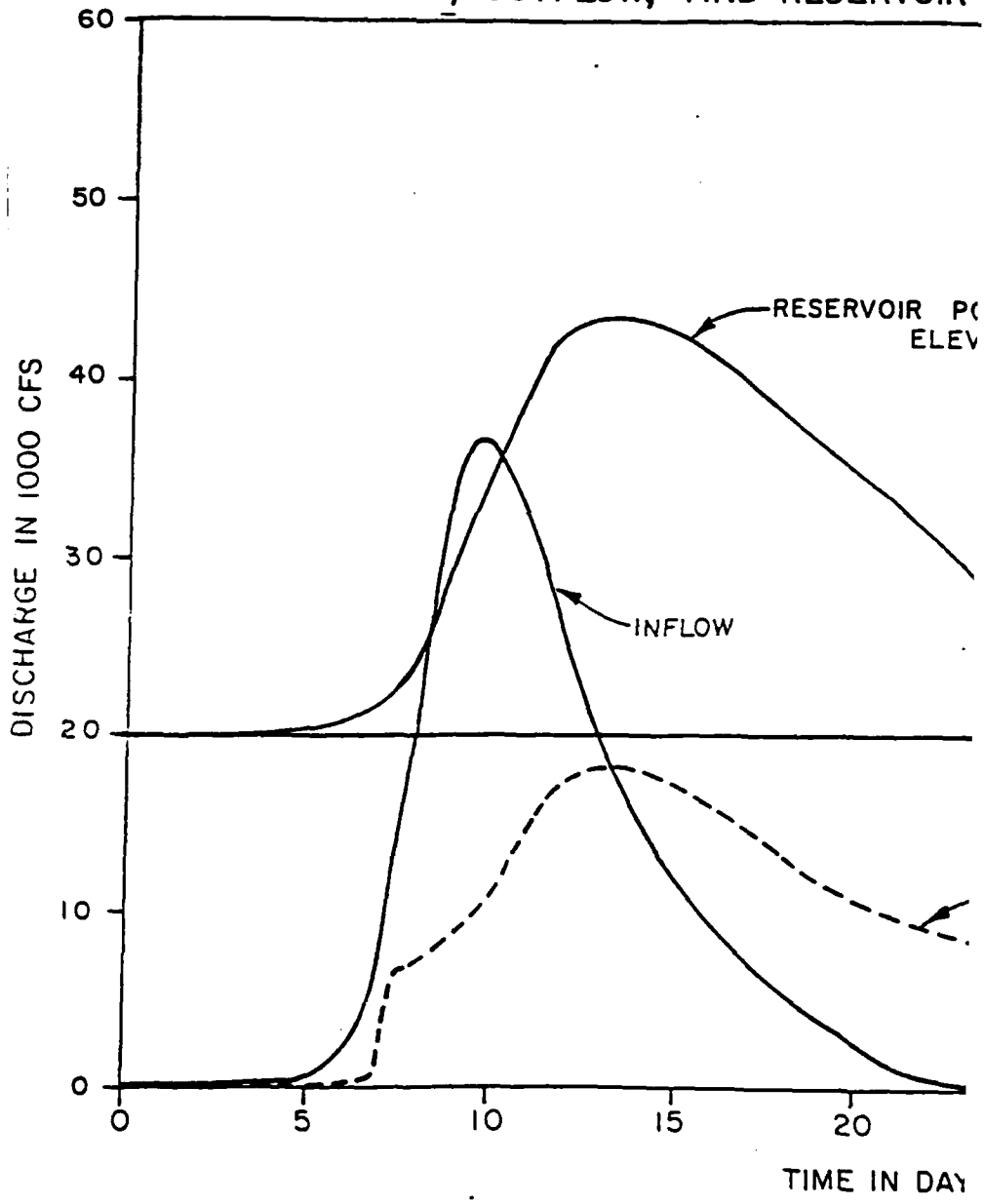
SCHEDULE OF REGULATION

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

(3)

PLATE 6

PROBABLE MAXIMUM FLOOD – "P
INFLOW, OUTFLOW, AND RESERVOIR



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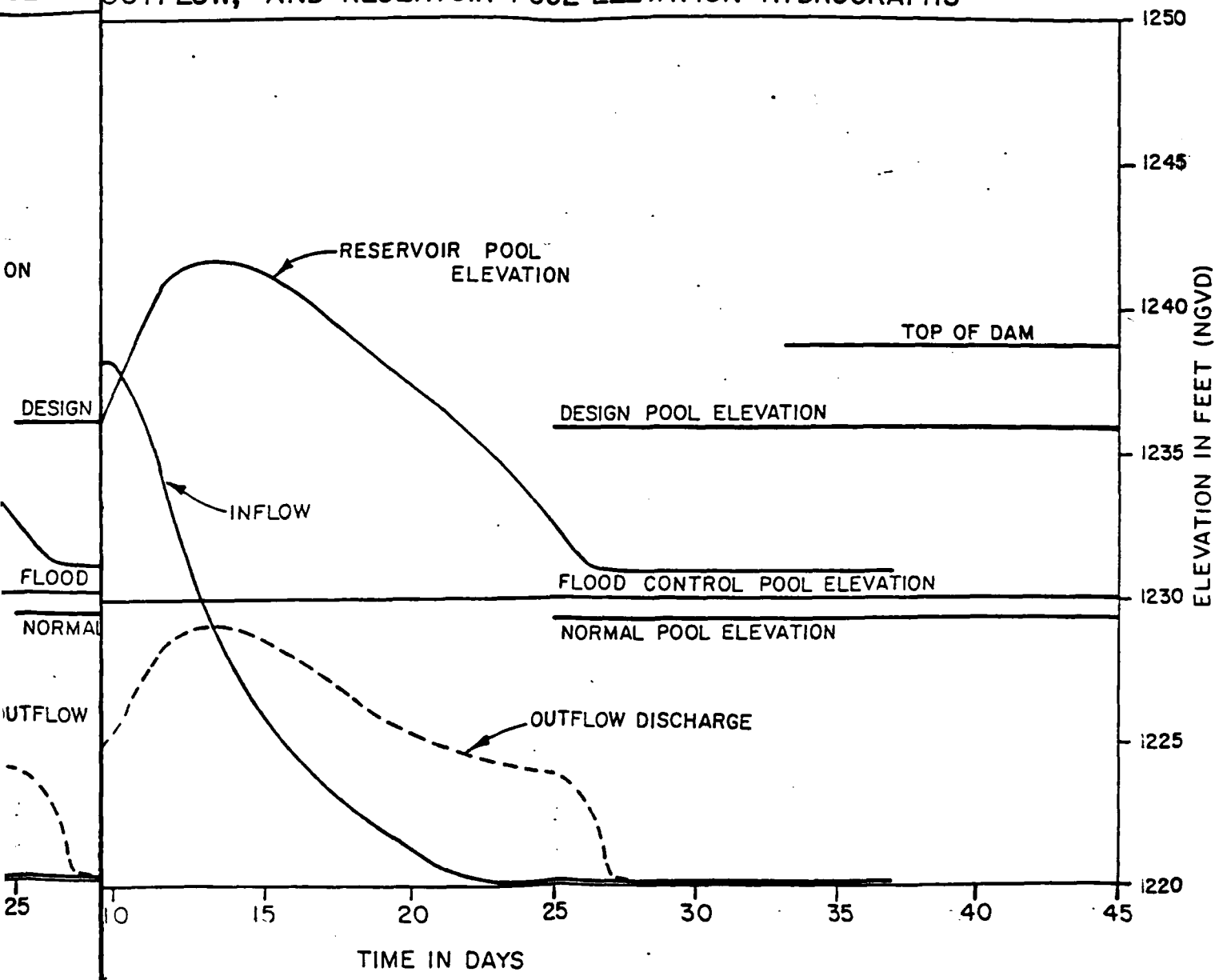
-OL ELE

BABLE MAXIMUM FLOOD – "PROJECT WITHOUT FAILURE"
OUTFLOW, AND RESERVOIR POOL ELEVATION HYDROGRAPHS



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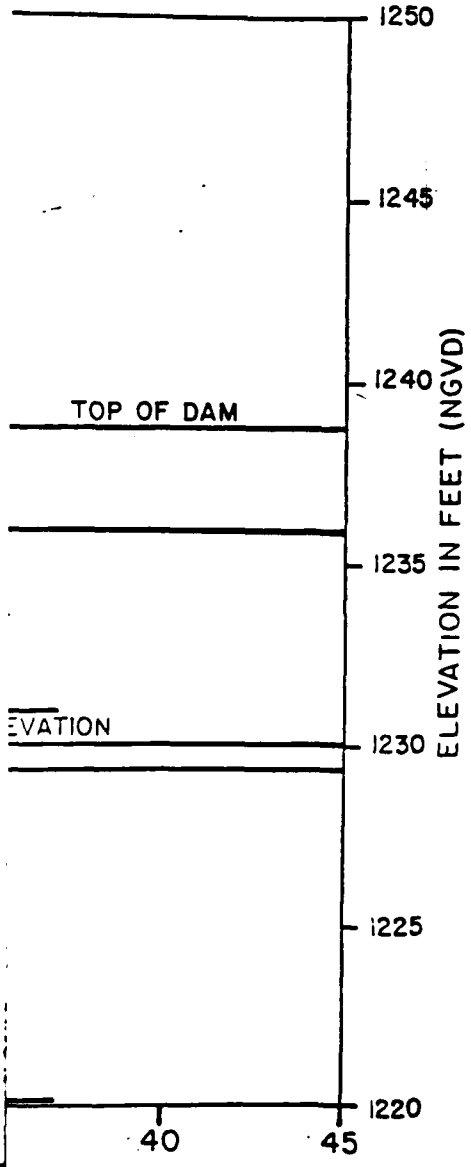

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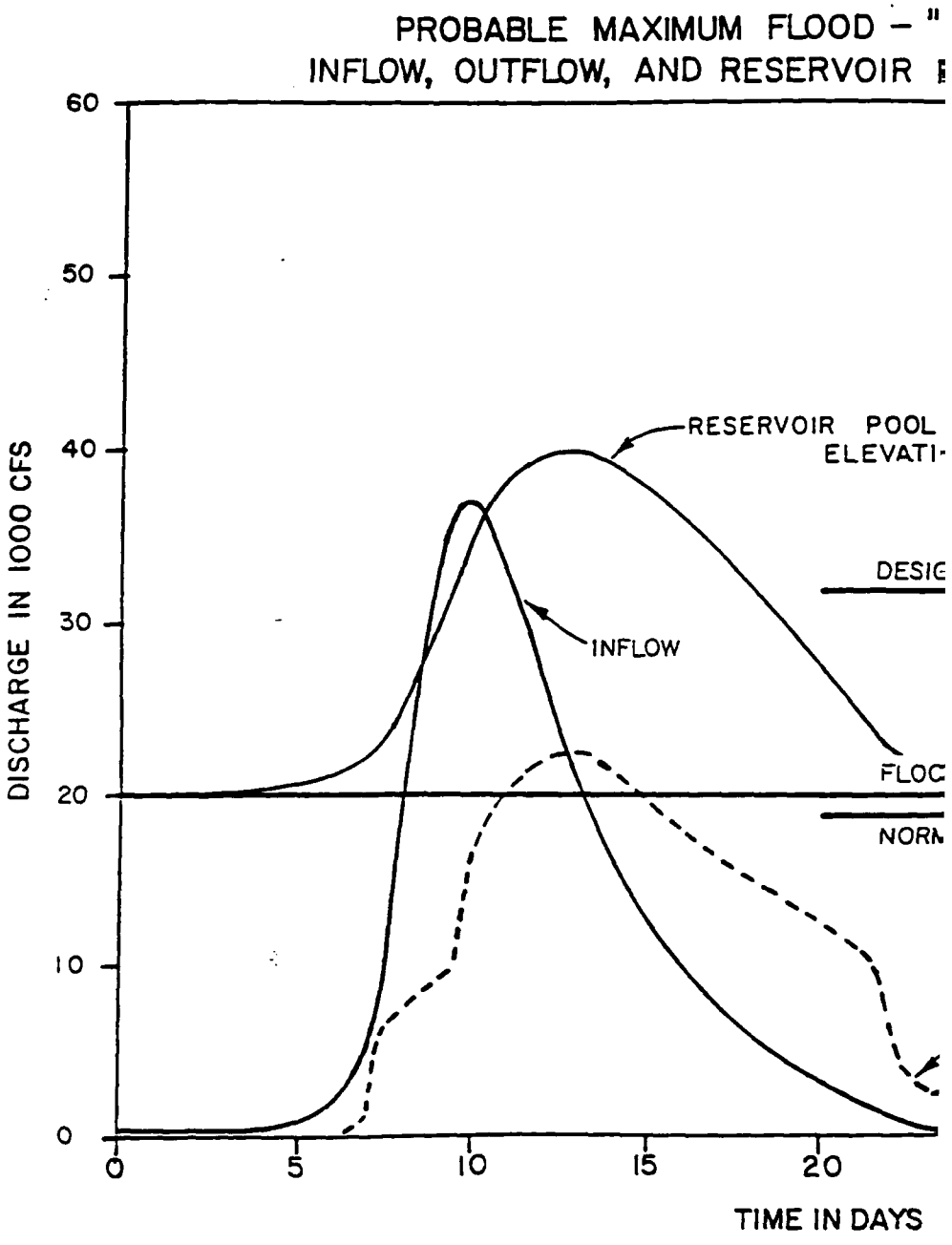

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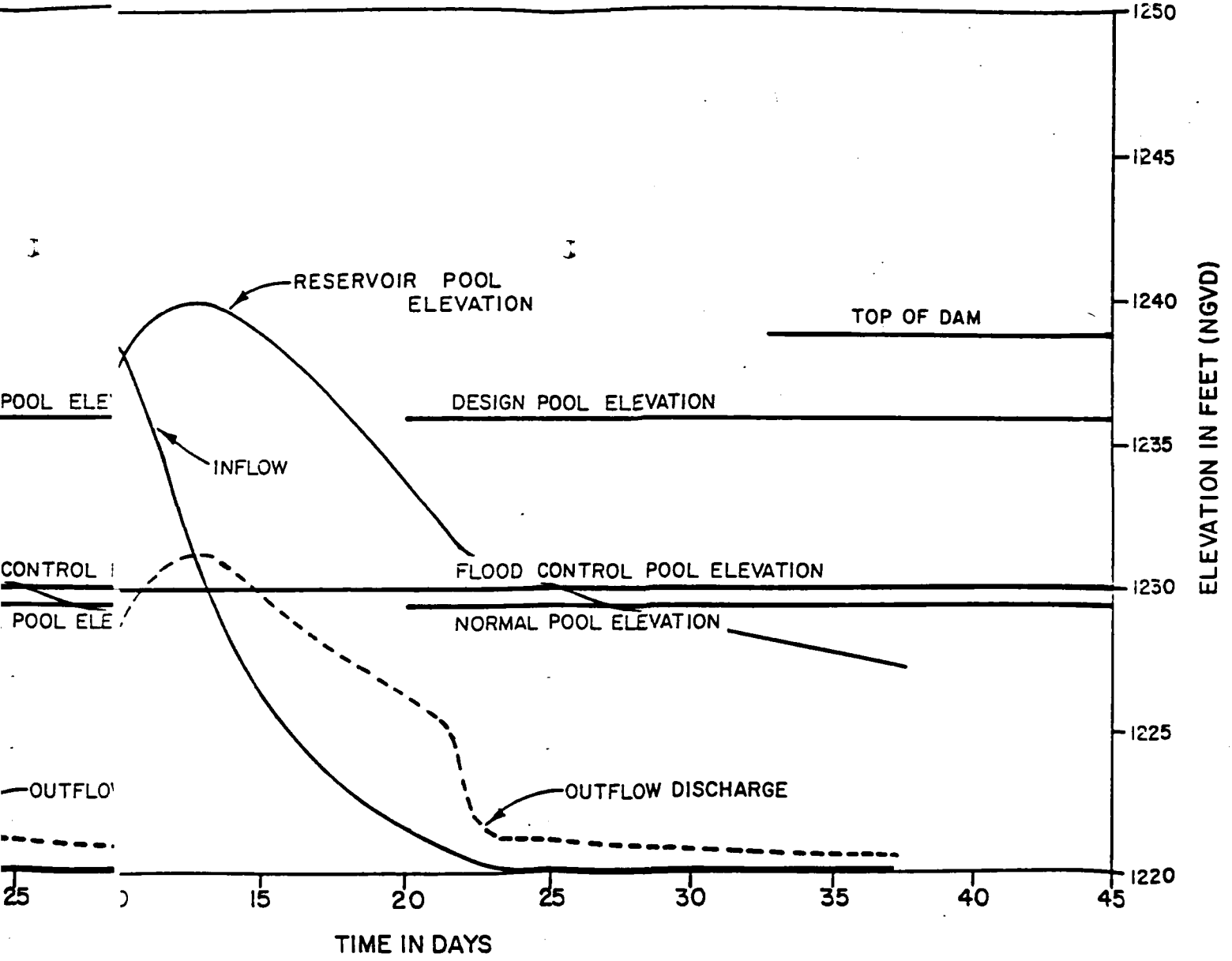

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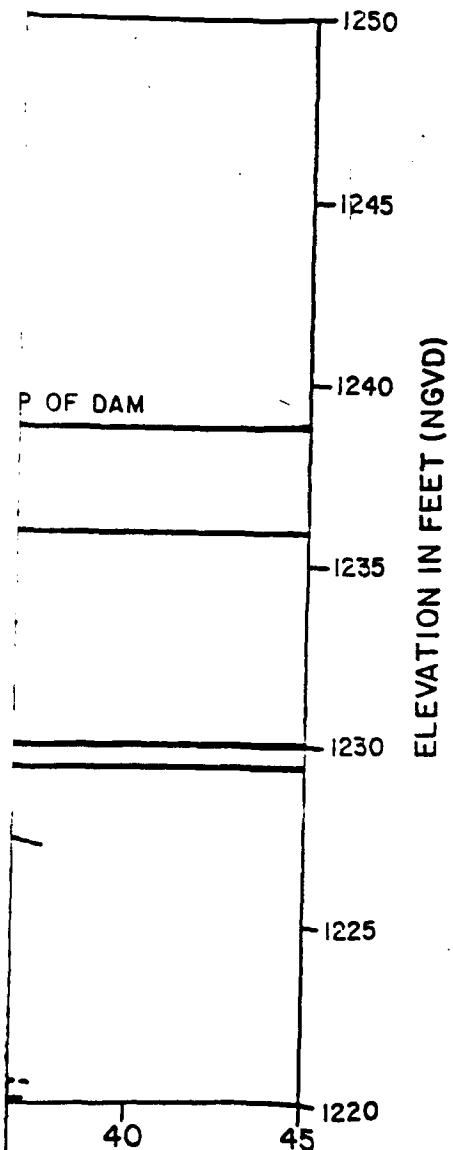

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EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
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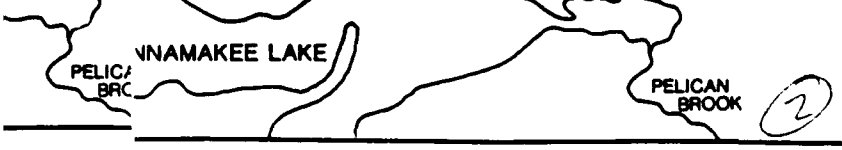
U.S. ARMY CORPS OF ENGINEERS

PLATE 8



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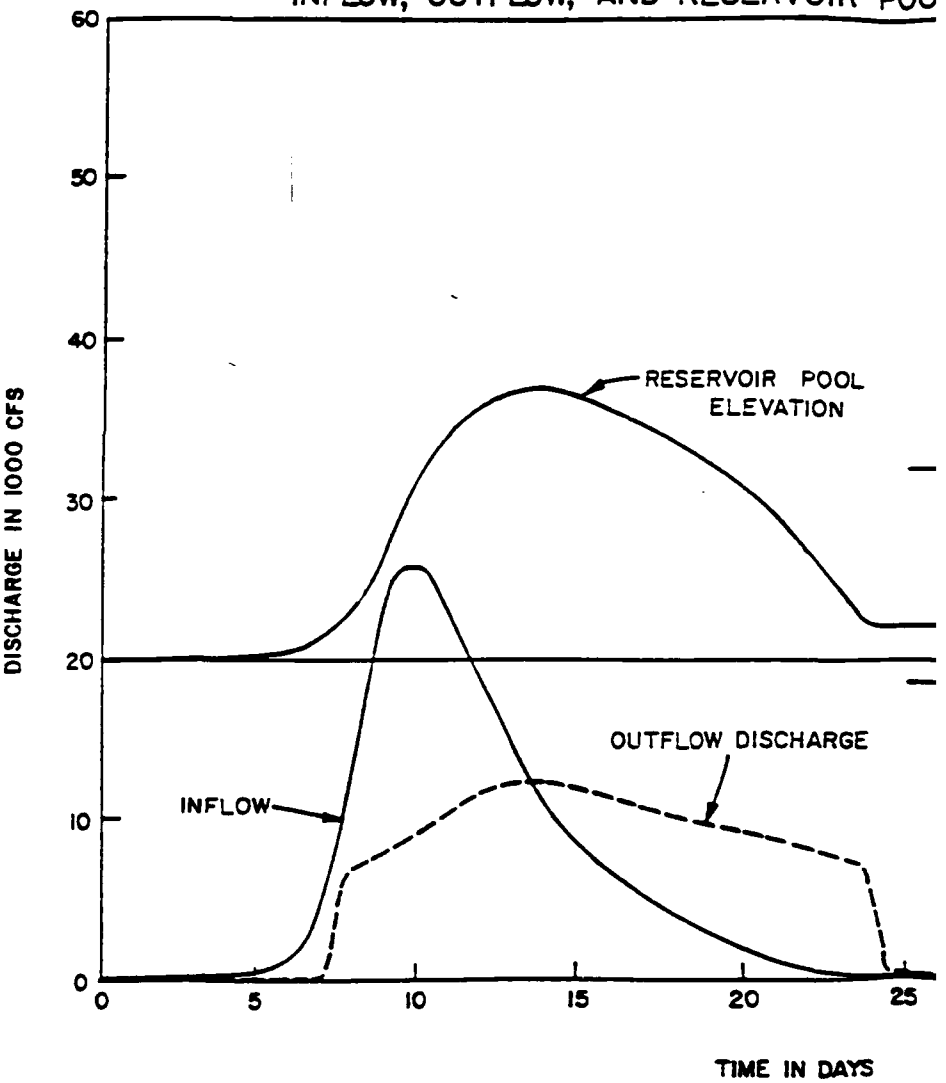

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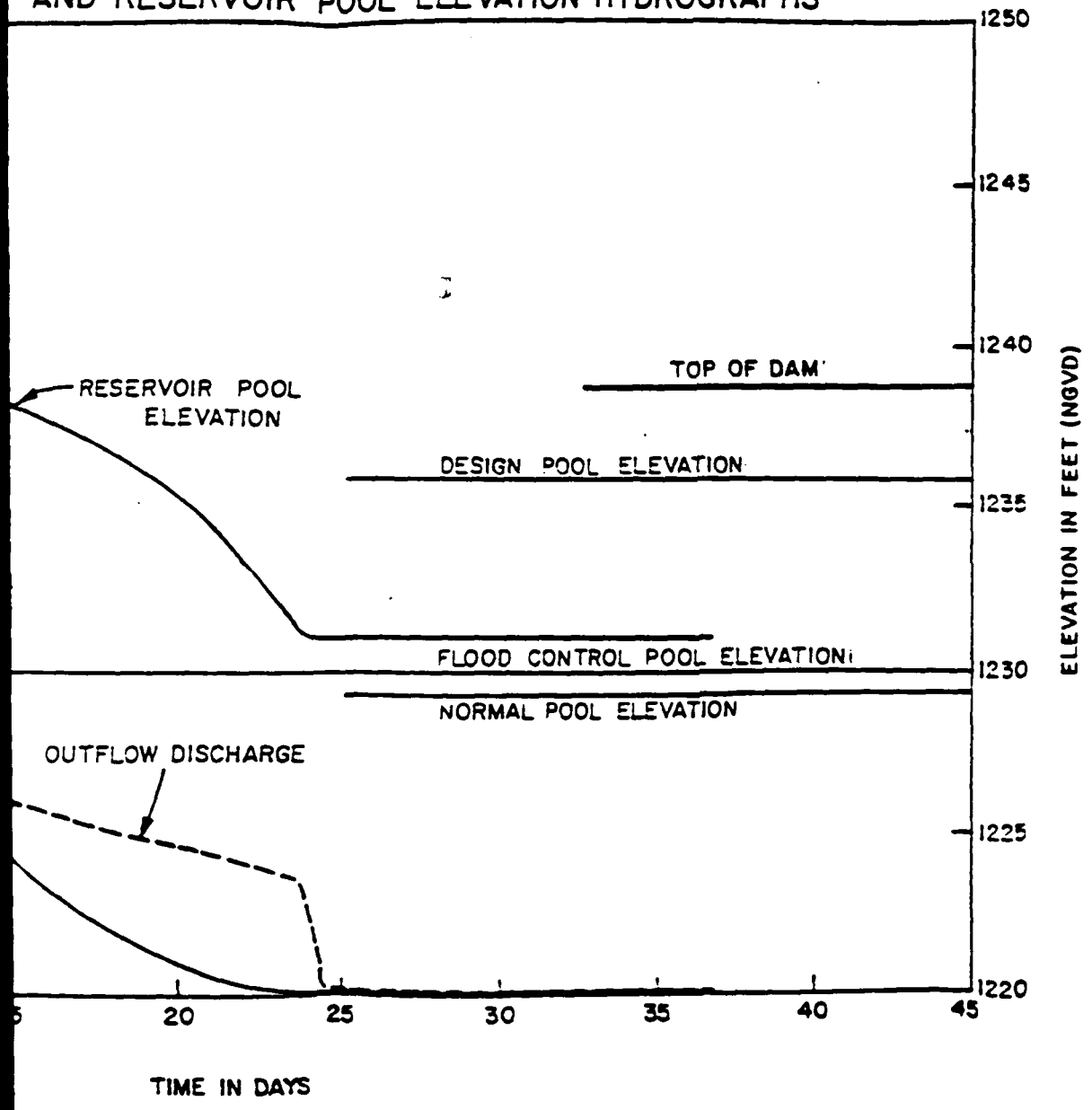

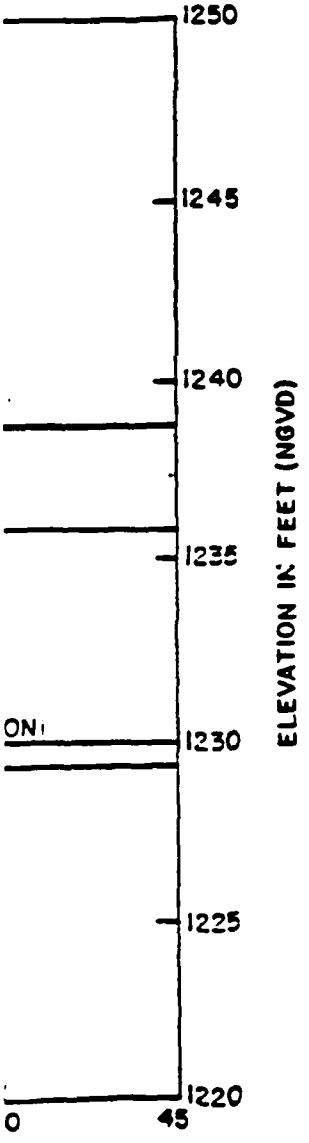

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EMERGENCY ACTION PLAN
PINE RIVER DAM
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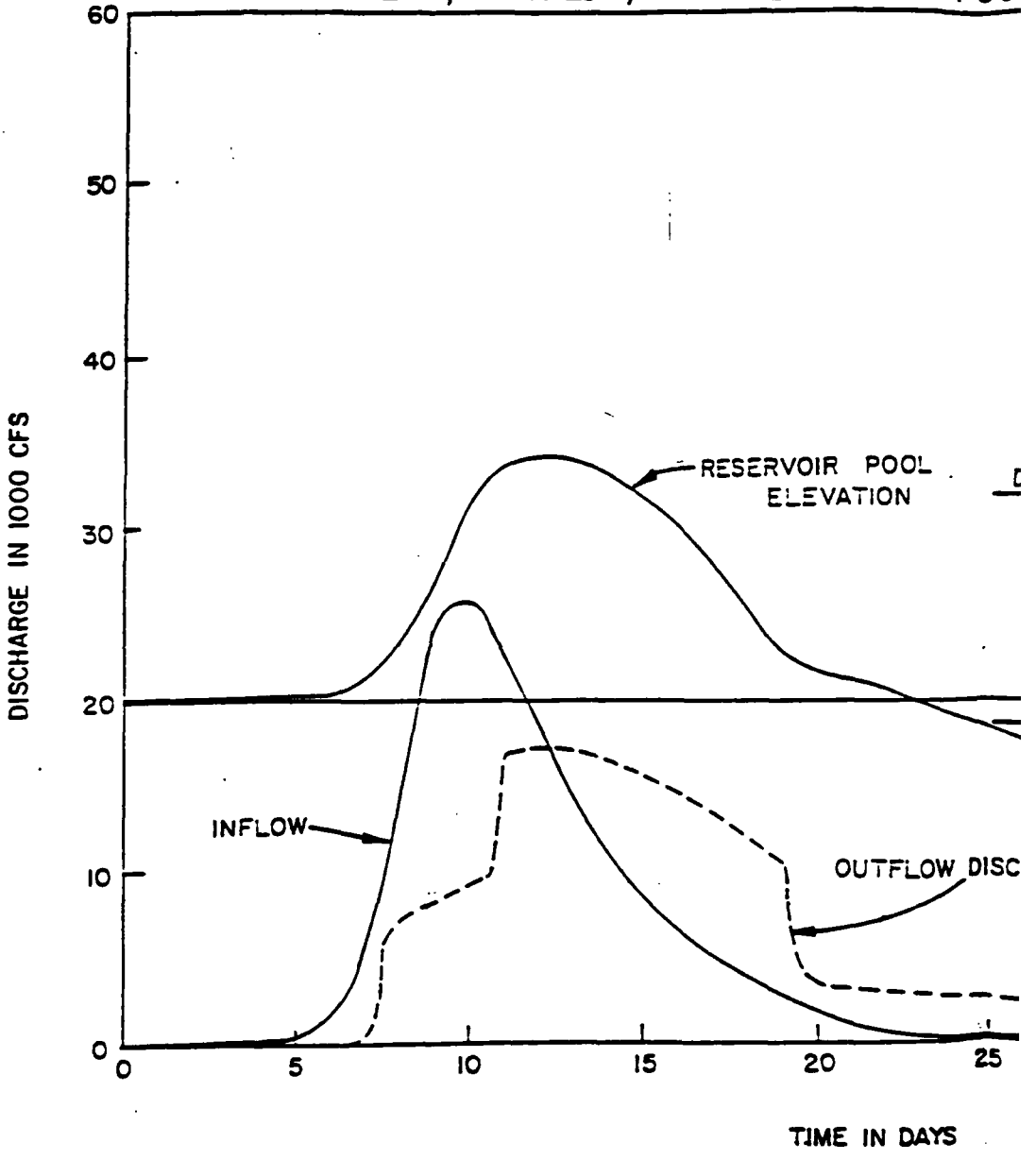

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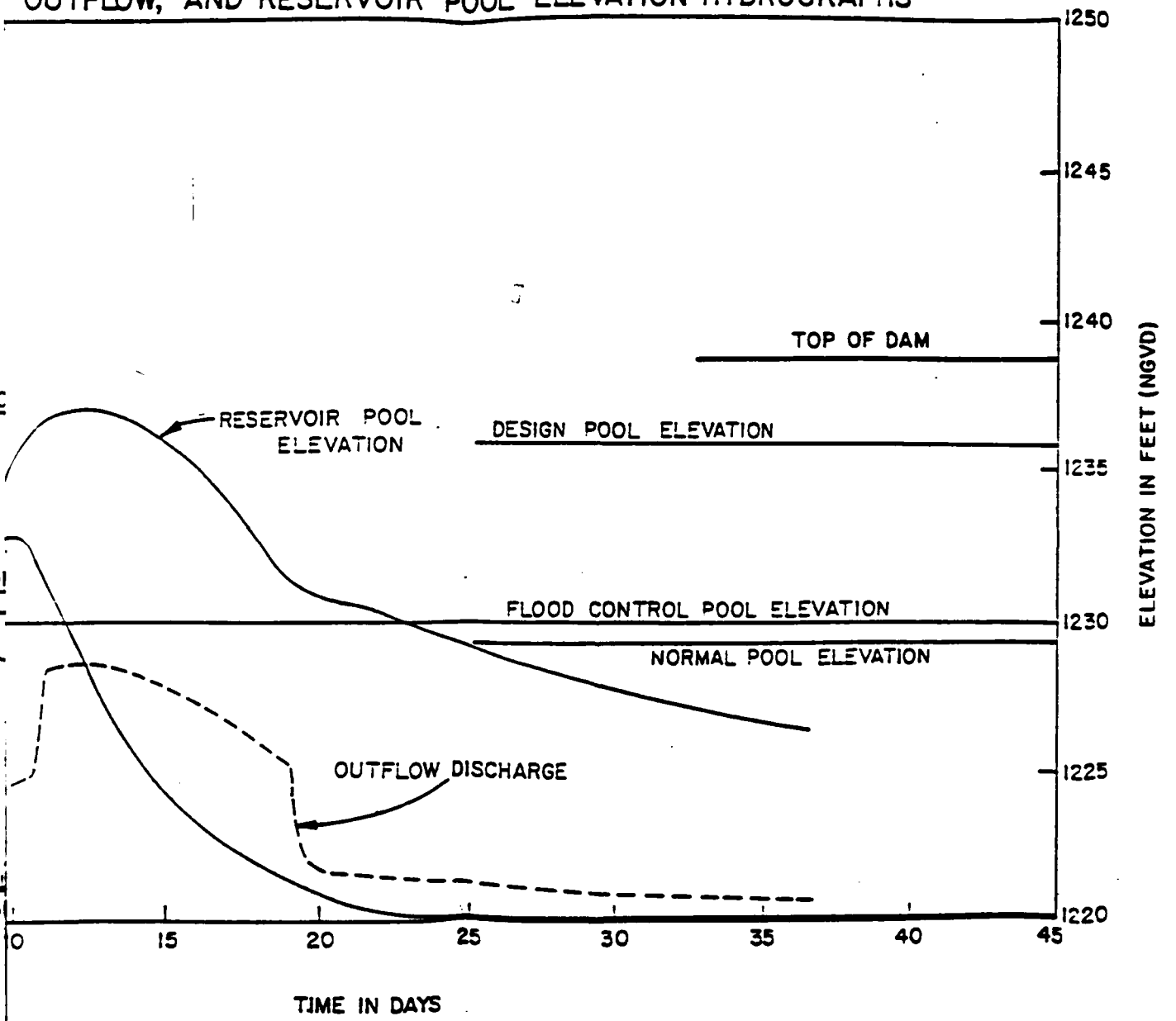

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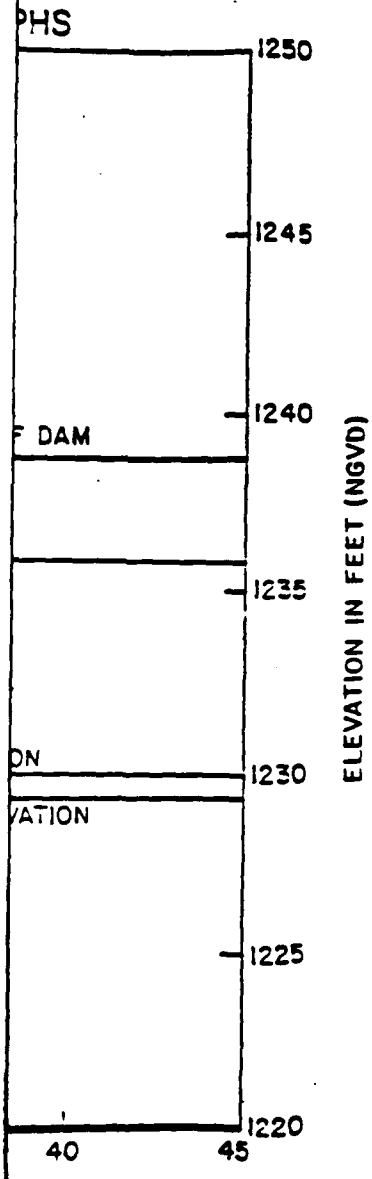

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EMERGENCY ACTION PLAN
PINE RIVER DAM
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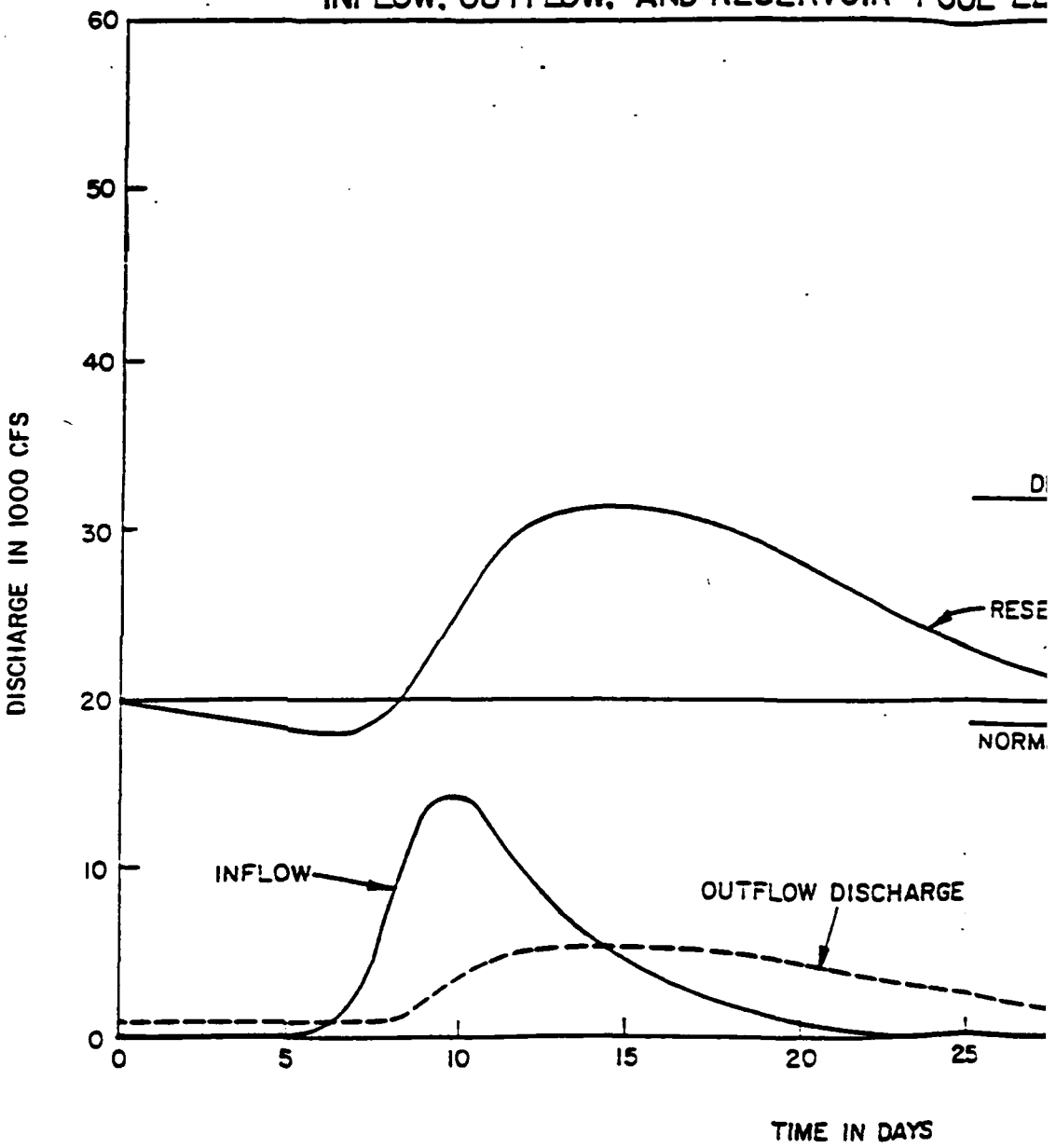
PLATE 10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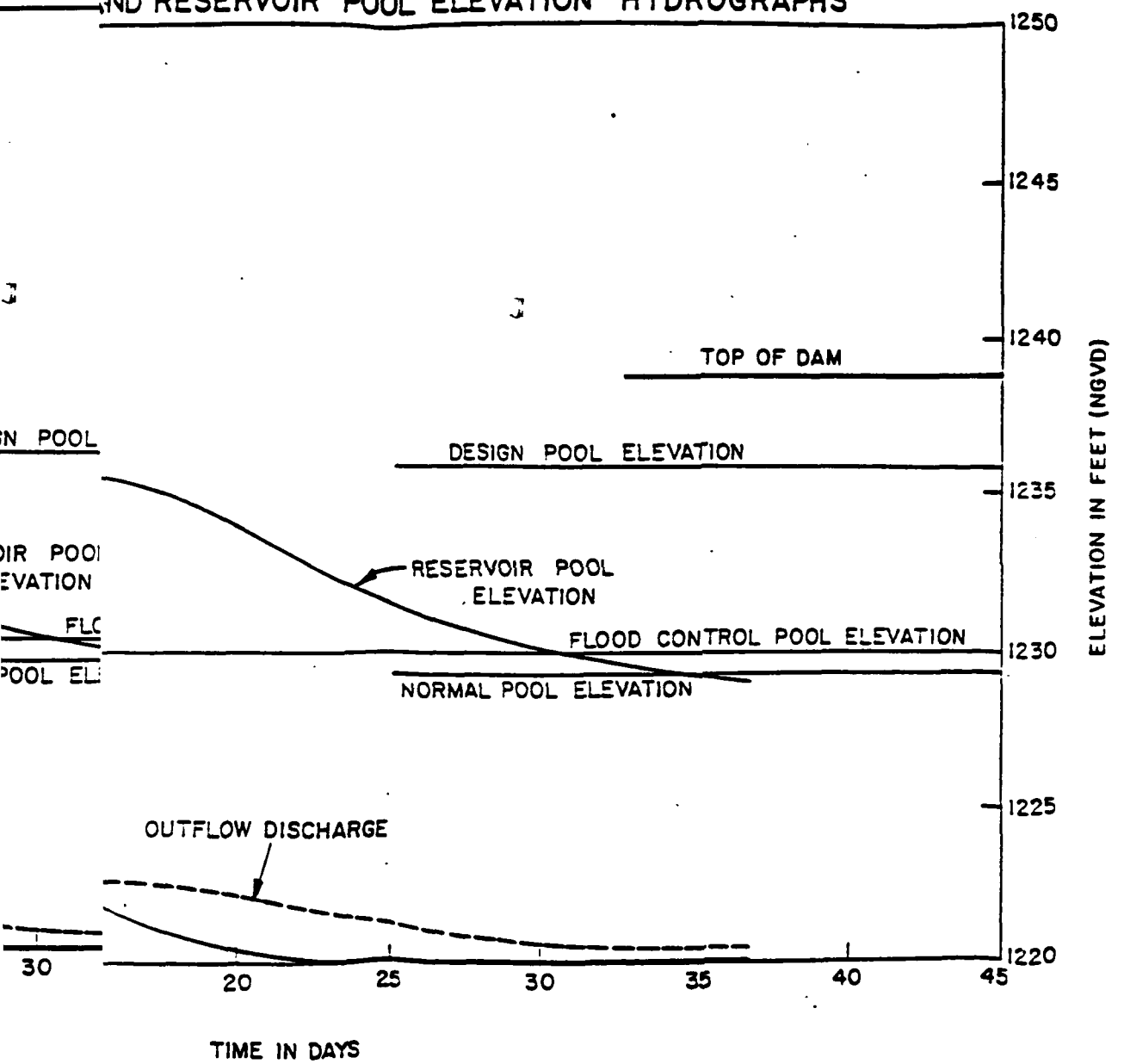

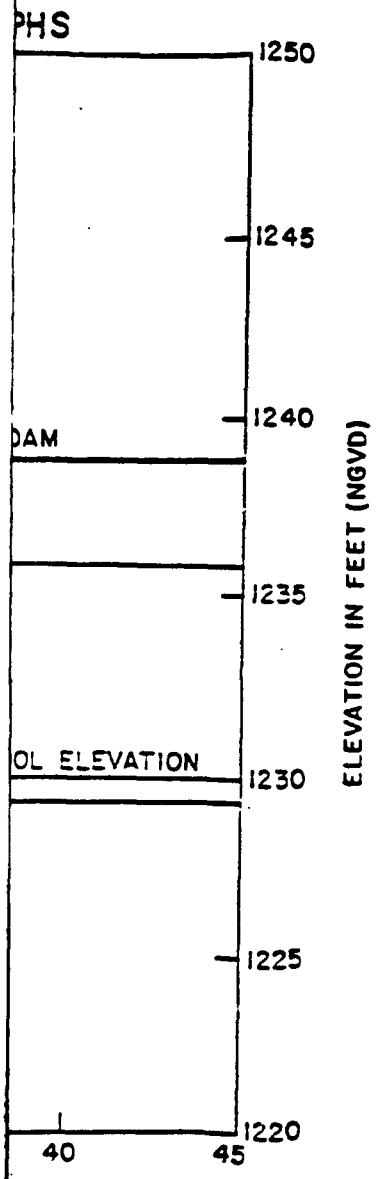

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EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
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ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

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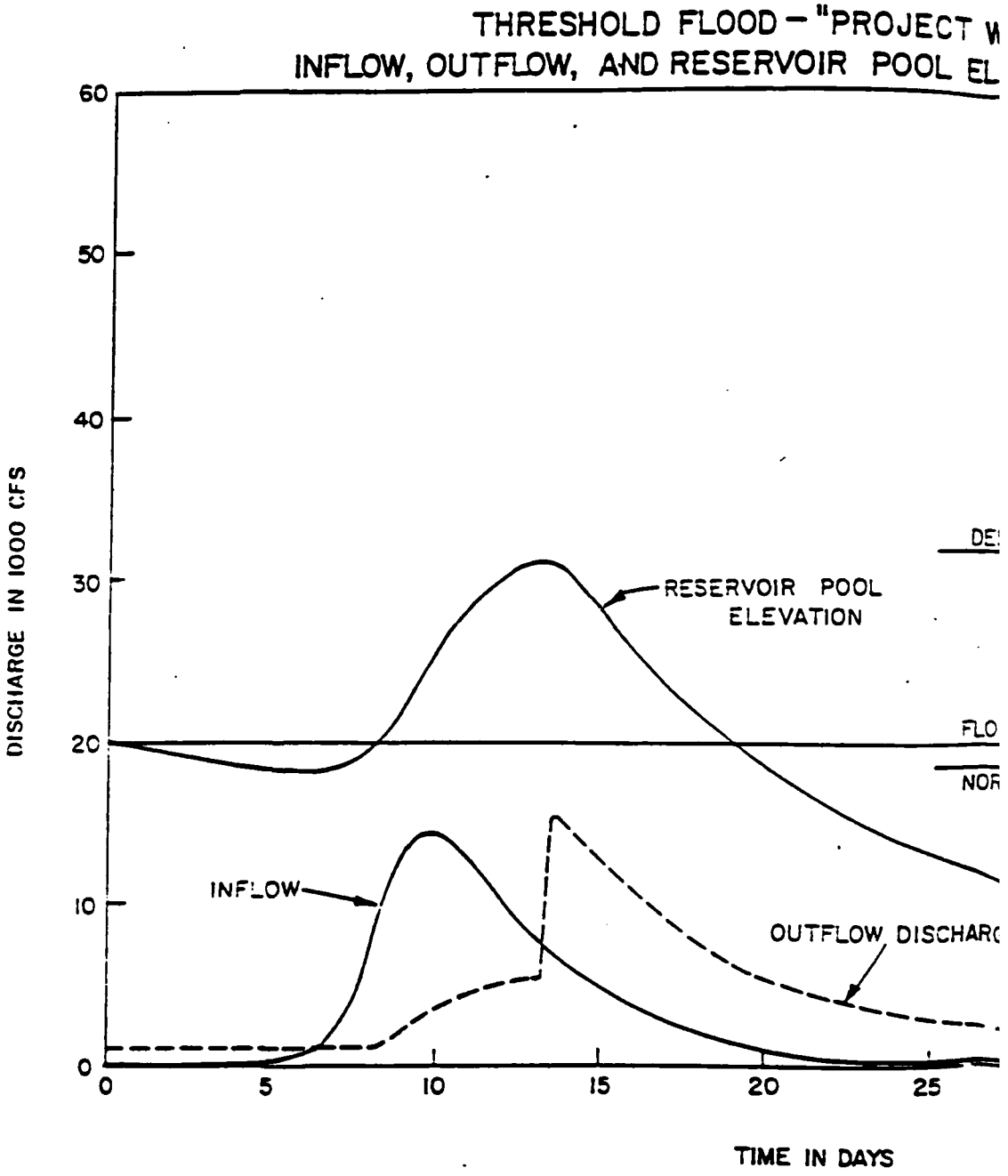
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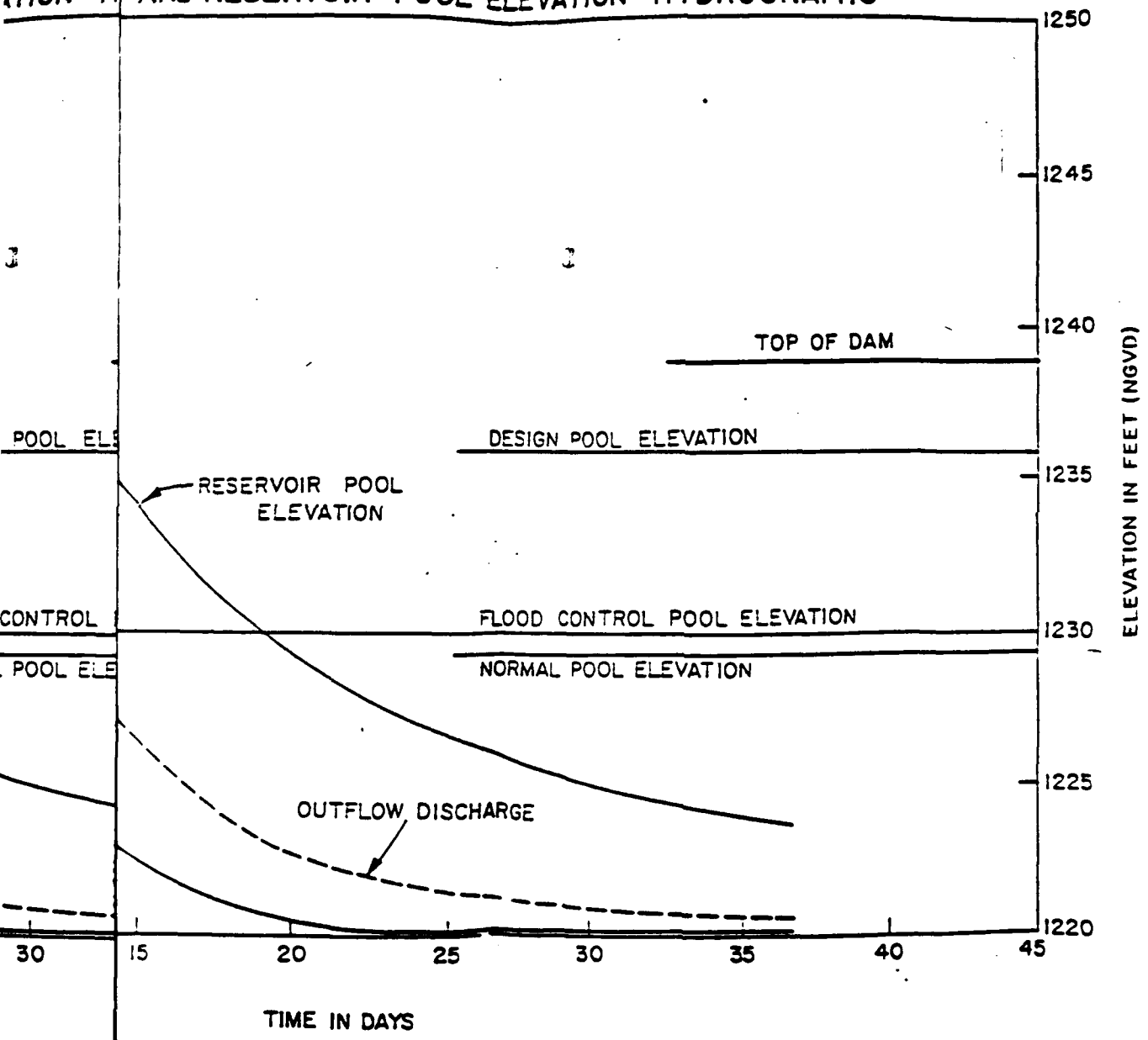

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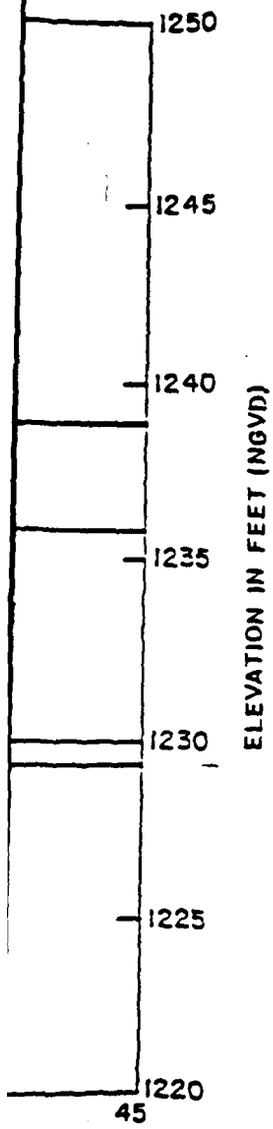

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EMERGENCY ACTION PLAN
PINE RIVER DAM
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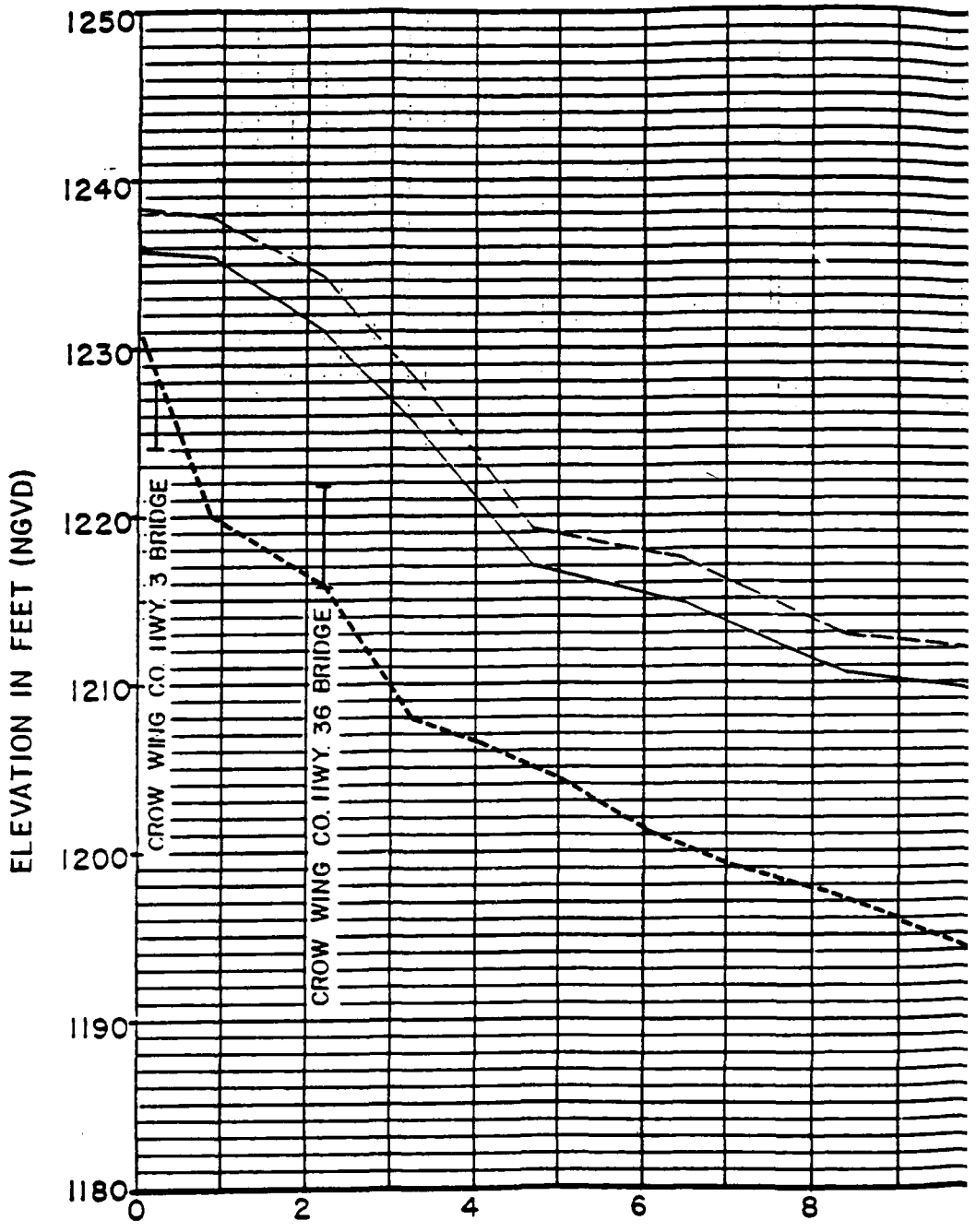
PLATE 12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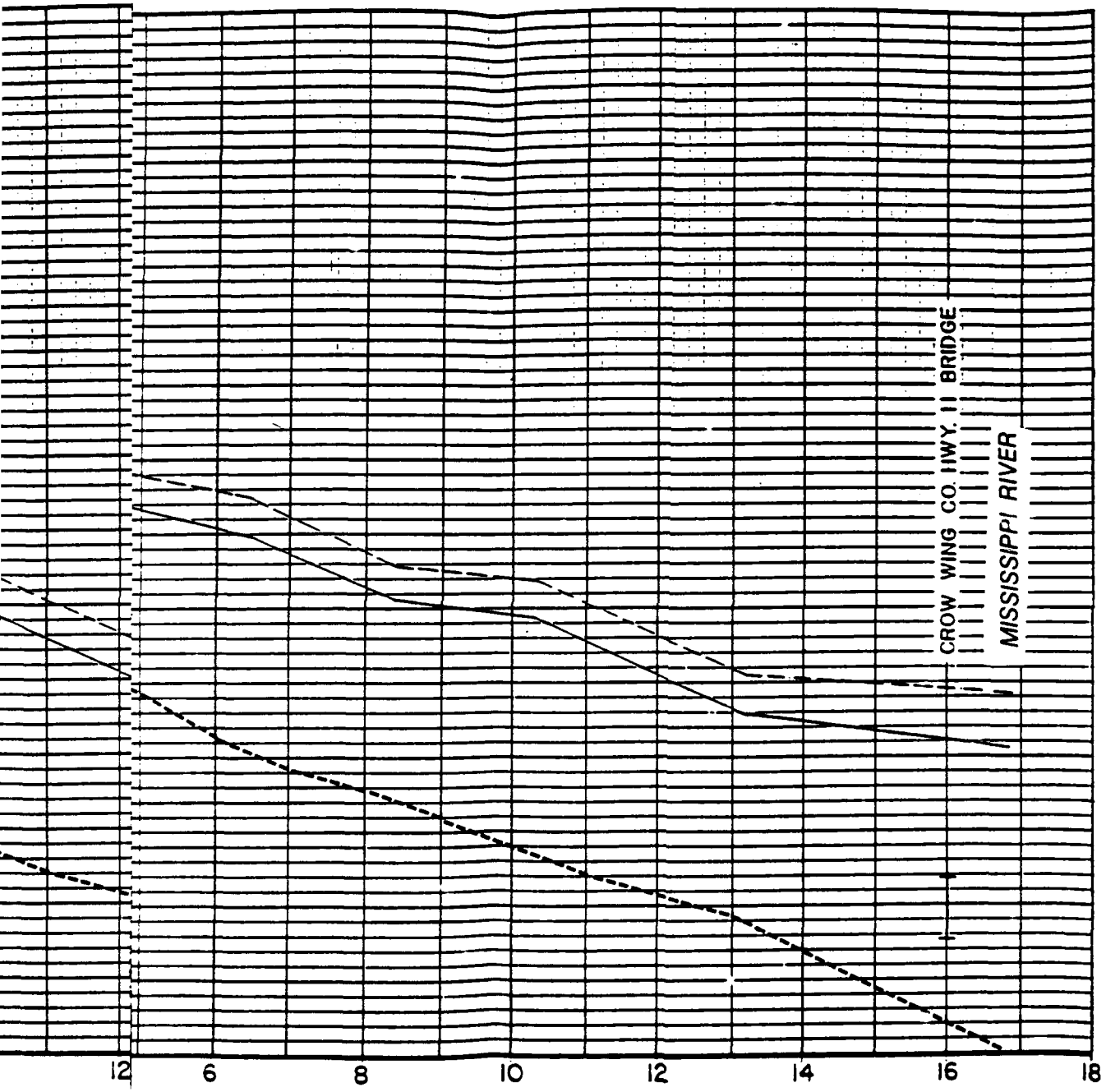

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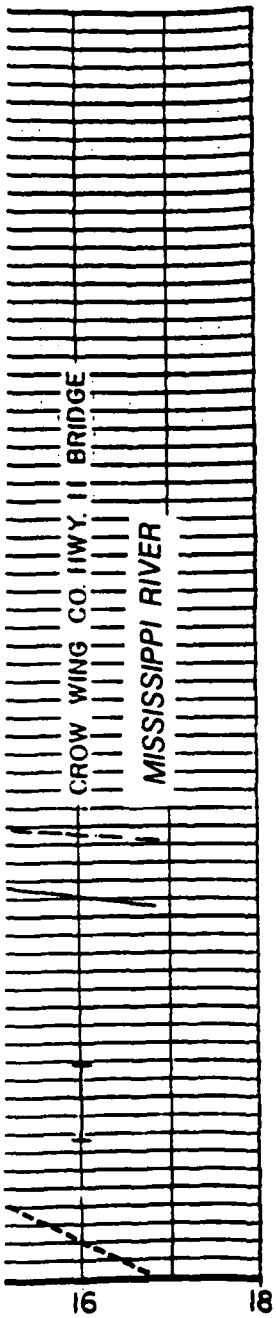

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EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
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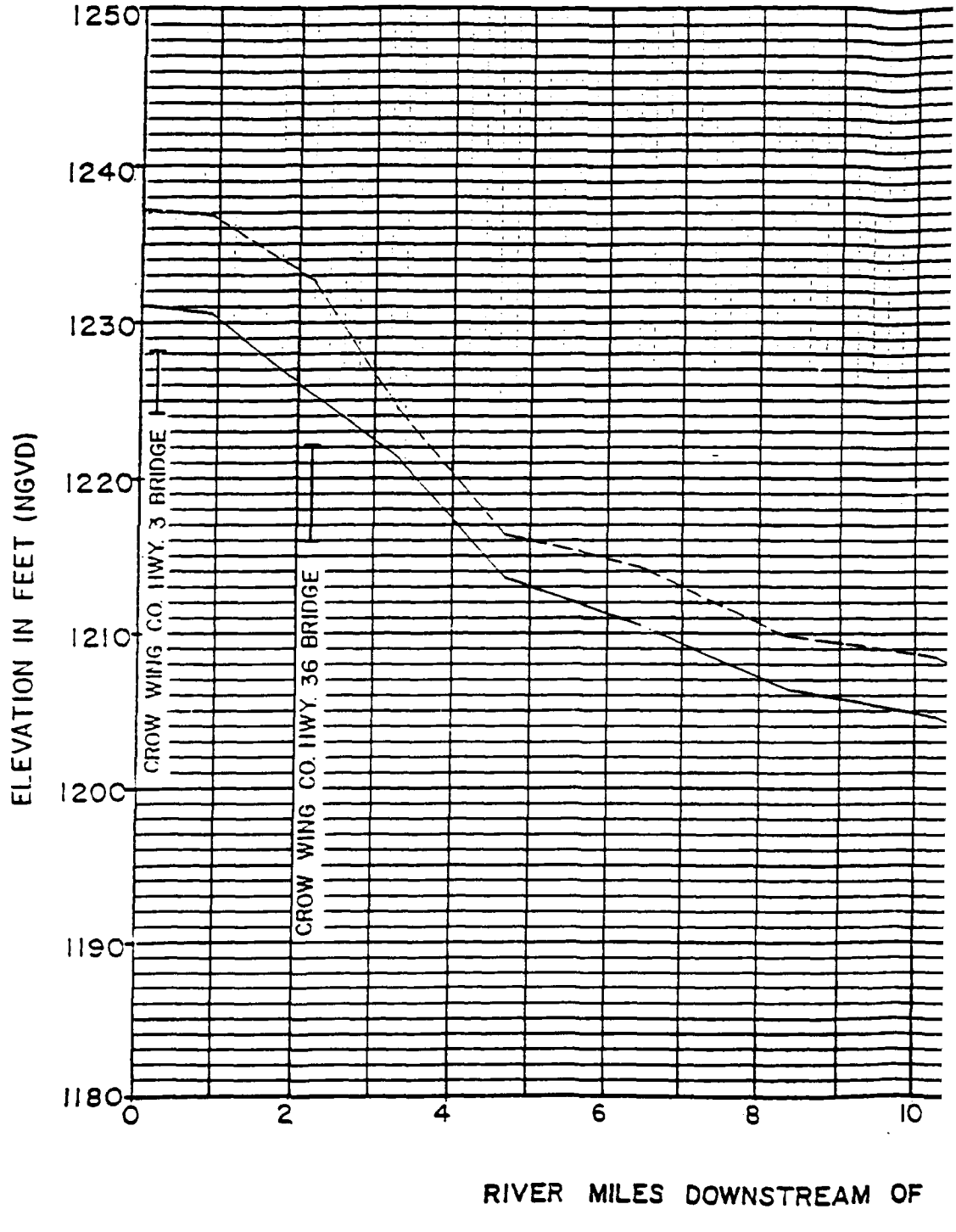
U.S. ARMY CORPS OF ENGINEERS

PLATE 13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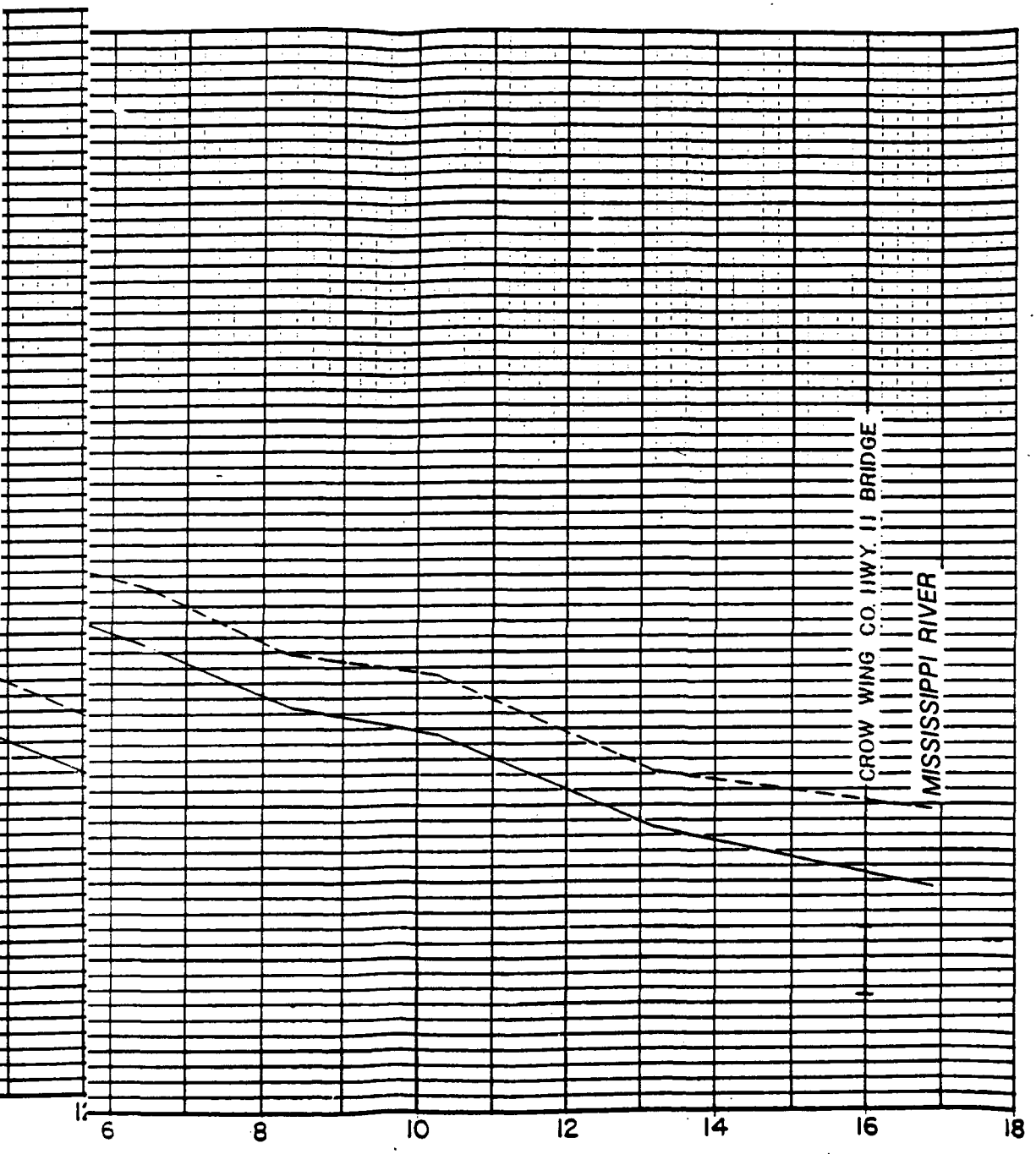

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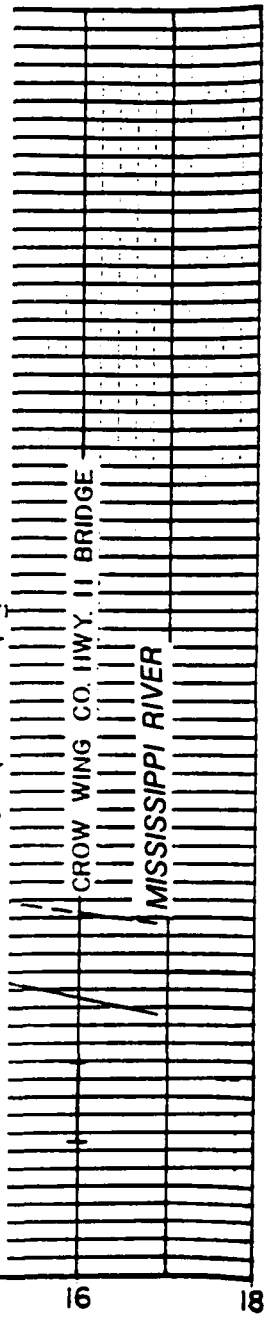

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EMERGENCY ACTION PLAN
PINE RIVER DAM
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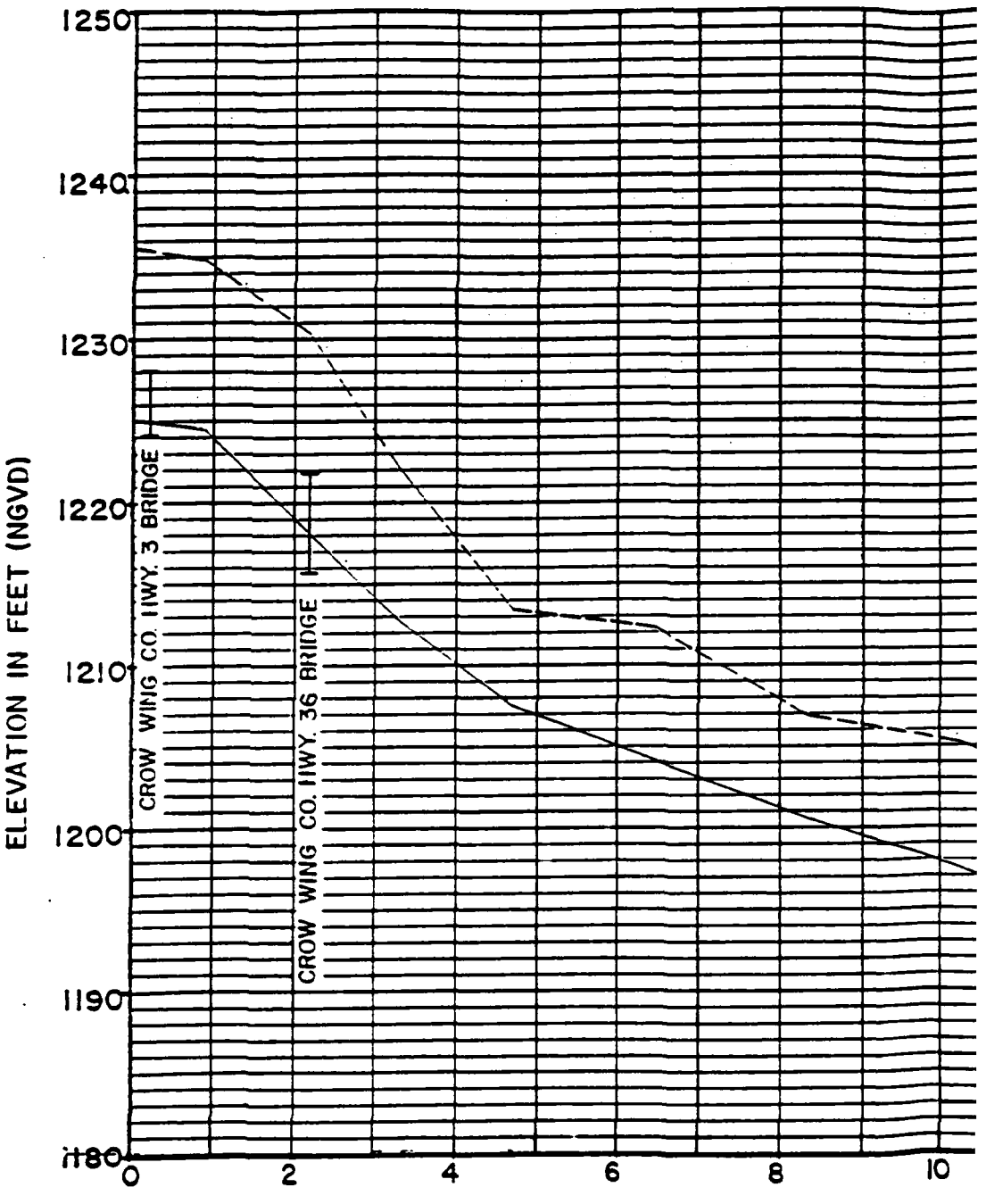
U.S. ARMY CORPS OF ENGINEERS

PLATE 14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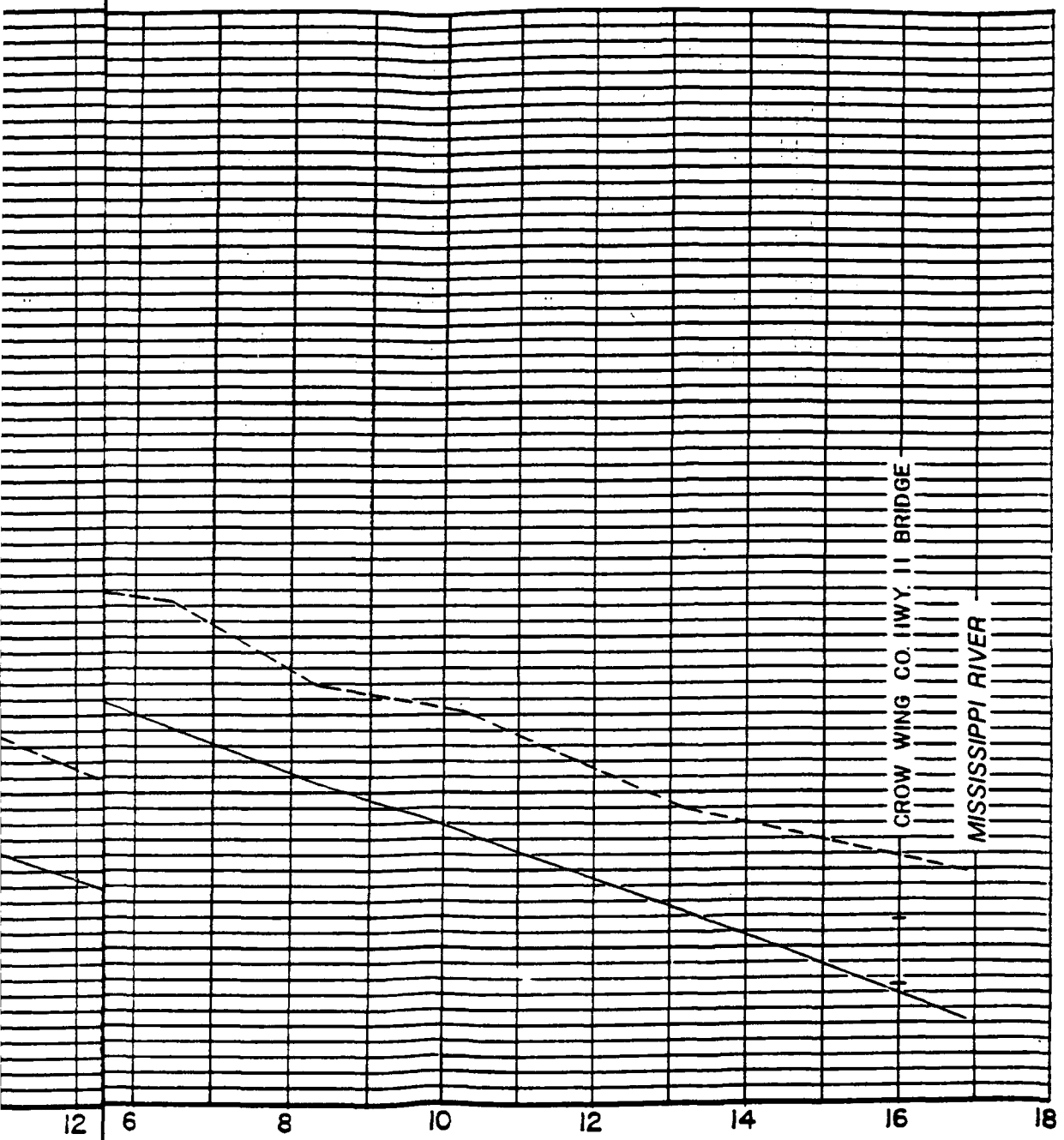

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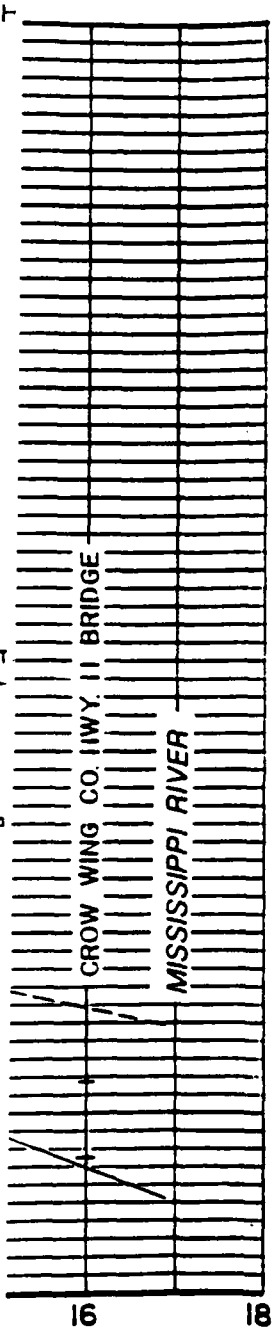

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CREST PROFILES THRESHOLD FLOOD WITHOUT AND WITH FAILURE

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE 15

COMPARISON OF COMPUTED OUTFLOW RATES

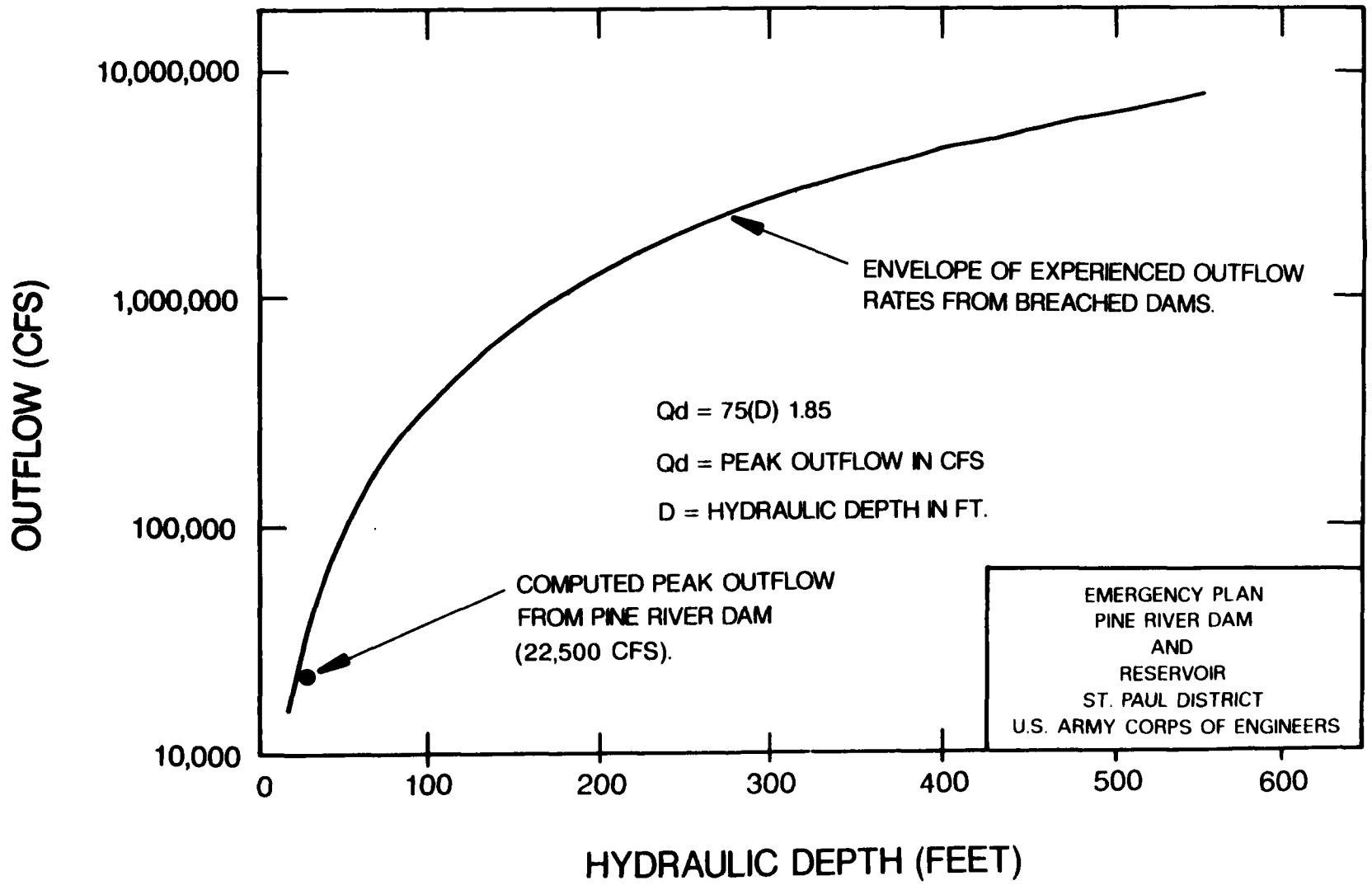

PLATE 16

APPENDIX A

EMERGENCY IDENTIFICATION SUBPLAN

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TABLE

APPENDIX A
EMERGENCY IDENTIFICATION SUBPLAN

A-1. Introduction

Conditions affecting the operation of Pine River Dam could result in a hazard to life and/or property as a result of high reservoir levels and/or sudden release of large volumes of water. Early identification of the existence or potential for occurrence of such conditions is essential as a basis for initiating emergency operations and/or repairs and for issuing appropriate notifications to higher authorities and potentially affected parties.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for identifying impending and existing emergencies affecting the operation and safety of Pine River Dam.

b. Scope

This subplan deals with identification of impending and existing emergencies related to operation error, excessive seepage, foundation failure, abutment failure, extreme storm, and equipment failure. Instructions are included concerning the following items:

(1) Monitoring and reporting conditions

(a) Routine - during duty hours. Monday through Friday (0800-1630).

(b) Nonroutine - on a 24-hour basis or as directed by the District Office.

(2) Communications between the project office and the St. Paul District Office.

(3) Criteria for action including declaration of a preemergency or emergency and activation of the notification subplan.

c. Applicability

This subplan applies to all Corps elements and field offices concerned with operation of Pine River Dam and Reservoir.

A-2. Definitions

a. Preemergency

A preemergency condition is one in which some impending or existing threat to the safe operation of the dam or reservoir is identified but no significant hazard to life or property is expected. Declaration of a

preemergency is internal to the Corps of Engineers and does not require notification of other parties or warnings to evacuate.

b. Emergency

An emergency condition is one in which the occurrence of a significant hazard to life and/or property is very probable or certain. Conditions justifying declaration of an emergency may be imminent or longer term. Declaration of an emergency requires notification of key personnel and issuance of warnings to evacuate potentially hazardous areas.

c. Resource Manager

The term Resource Manager means the dam tender or the individual in charge at the Pine River Dam and Reservoir project site.

d. Mississippi Headwaters Project Office

The term Mississippi Headwaters Project Office means the person in charge of the Mississippi Headwaters Project Office.

e. District

The term District means one of the following elements depending on which is appropriate for the situation at hand.

(1) Dam Safety Officer. The Dam Safety Officer must be kept informed of all preemergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required for the preemergency or emergency. Also responsible for keeping the Dam Safety Committee and the NCD Dam Safety Officer informed of the preemergency or emergency.

(2) Project Operations Branch. Responsible for identifying a person-in-charge of the preemergency or emergency. Responsible for keeping the Dam Safety Officer informed of the preemergency or emergency. Also responsible for matters involving normal dam operations and/or other matters not covered by the other District elements.

(3) Emergency Operations Center. Provides 24-hour telephone contact with the District Office. Responsible for keeping the Dam Safety Officer, the Commander/District Engineer, and NCD in contact with the operations and personnel. Also responsible for matters involving national security, disasters, and mobilization.

(4) Water Control Center. Part of Hydrology Section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. The Control Center collects and monitors hydrometeorological data and directs the Resource Manager to make discharge modifications.

(5) Geotechnical Design Section. A section in the Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving the structural integrity of the dam.

(6) Design Branch. Responsible for matters involving the structural integrity of the outlet structures.

(7) Project Management Branch. Responsible for management support.

(8) Planning Division. Responsible for management support and matters involving environmental analysis and cultural resources.

A-3. Responsibility for Conduct

a. Resource Manager

(1) Carries out routine surveillance (paragraph A-4.a.).

(2) Carries out nonroutine observations and measurements as directed by the District (paragraph A-4.b.).

(3) Advises the District of potentially hazardous situations (paragraph A-4.c.).

(4) Maintains proper records of communications (paragraph A-5).

(5) Acts independently, when required by disruption of communications or the urgency of the circumstances, to declare a preemergency or emergency (paragraph A-8) and to activate the notification subplan.

b. Mississippi Headwaters Project Office

(1) Provides direction and supervision to the Resource Manager in coordination with the District Office.

(2) Provides assistance to District as requested.

(3) Assumes responsibilities of the District if communications between the project area and District Office are disrupted.

c. District

(1) Carries out routine monitoring of conditions potentially affecting regulation of Pine River Dam (paragraph A-6.a.) and alerts the Resource Manager of situations requiring increased readiness and/or 24-hour supervision.

(2) Provides guidance to the Resource Manager on all potentially hazardous situations that arise and directs any nonroutine observations and measurements needed to assist in identification, confirmation, or analysis of existing or impending threats to safe operation of the dam (paragraph A-6.b.).

(3) Provides personnel for on-site evaluation of potentially hazardous conditions related to geology, soils and other aspects requiring expert analysis.

(4) Declares the existence of preemergency and emergency conditions and directs activation of the notification subplan.

(5) Maintains the subplan (paragraph A-9).

A-4. Observations, Tests and Reports by Resource Manager

a. Routine Observations and Tests

(1) Monday through Friday (0800-1630)

(a) Maximum, minimum, and observed temperature.

(b) Local precipitation at maintenance building.

(c) Wind speed.

(d) Pool and tail-water elevations.

(e) Lake gage reading.

(f) Gate setting.

(2) Weekly

(a) Snow cover, water content of snow (seasonal) at maintenance building.

(b) Radio and other communications equipment.

(3) Monthly

(a) Visual inspection for excessive seepage on downstream face of embankments, outlet works, abutment areas, and the valley floor immediately downstream of the dam. Visual inspection for excessive seepage on downstream face of perimeter dikes and adjacent abutments.

(b) Visual inspection for slope failure on both faces of all embankments and perimeter dikes that are in contact with standing water.

b. Nonroutine Observations and Tests

(1) Perform snow surveys as requested.

(2) Perform comprehensive examination of seepage (amount, rate of change of flow, and presence of fines) whenever potential problems are observed.

(3) Monitor precipitation gages as directed by the District Office when significant rain is occurring.

(4) Examine all areas of embankment hourly if evidence of significant slope failure is found (to be continued until directed by District to cease).

(5) Perform semi-annual piezometer readings.

(6) Perform other observations and tests as directed by the District Office.

c. Reports

(1) To the Chief, Water Control Center

(a) Precipitation of 1.5 inches or more in the vicinity of the dam in 24-hours or less.

(b) Pool elevation above seasonal normal.

(c) Severe ice conditions or temporary constrictions downstream of dam.

(d) Any conditions likely to require a change in gate operations or mode of regulation.

(2) To the Chief, Geotechnical Design Branch

(a) Any conditions indicating distress of an embankment.

(b) Indications of unusual seepage.

A-5. Records

The Resource Manager shall keep a log of all telephone, radio, or other communications received from or sent to the District Office. This log should be a bound ledger or notebook used only as an official diary. Each communication will be described including:

a. Date.

b. Time.

c. Person calling or called.

d. Information transmitted/instructions received.

e. Action requested by the District.

f. Action taken in response to request.

g. Result of action.

h. Remarks.

i. Name of the operator issuing information/orders.

j. Initials of person receiving communications.

A-6. Observations, Tests, and Alerts by District

a. Daily Routine Observations and Tests

(1) Check weather forecasts for Pine River watershed.

(2) Check concurrence of pool level readings from staff gage and recording gage.

b. Nonroutine Observations and Tests

Specify additional observations and tests to be performed by the Resource Manager and make additional observations and tests as necessary to accomplish the following:

(1) Ensure proper functioning of all instrumentation.

(2) Assist in identification, confirmation, or analysis of existing or impending threats to safe operation of the dam.

c. Alerts

Provide alerts to the Resource Manager and appropriate District office personnel at the following times:

(1) When weather, ice, or other conditions require heightened readiness, increased surveillance, or the possible need for activation of the Emergency Operations Center.

(2) When consideration is being given to declaration of a preemergency or emergency.

A-7. Communications

a Normal

Communications between the District and Resource Manager will normally be by radio. Radios at the Hastings Electronic Service Center and the District's Emergency Operations Center will be manned on a 24-hour basis during all flood emergencies and whenever a preemergency or emergency is in effect. Radio frequencies and call letters for pertinent parties are listed in appendix C and table A-1.

b. Back-up

The telephone communications network between the District Office and Mississippi Headwaters Project Office will be used to back up radio communications. Office and home phone numbers of key District Office and Mississippi Headwaters Project Office personnel are listed in appendix C and table A-1.

c. Emergency

If both radio and telephone communications between the District Office and the Pine River Dam Project Office are lost, others equipped with radio or telephone facilities will be called on for assistance. Those to whom application for assistance may be made are listed in appendix C and table A-1 along with the information for telephone and radio contacts.

A-8. Declaration of Preemergencies and Emergencies

a. Responsibility

The District Office is responsible for the declaration of premergencies or emergencies in all but extreme cases where the loss of communications or the speed of onset of a situation prevents the Resource Manager from conferring with the District Office. Preemergency and emergency declarations will be made by the Commander/District Engineer. The Dam Safety Committee will provide recommendations to the District Engineer.

b. Conditions Warranting Declaration

Not every situation requiring declaration of a preemergency or emergency can be specified. Initiative must be exercised by all involved personnel and each situation must be judged individually on the basis of all relevant factors.

(1) Preemergency

Examples of circumstances warranting declaration of a preemergency include the following:

(a) Spring runoff is always handled as a preemergency. During the remainder of the year, the occurrence of National Weather Service flood stage or a higher stage at the control point shall be the warranting factor.

(b) Malfunction of a flood control gate system during flood operations which impedes the release of water and increases the potential of an emergency.

(c) Minor seepage problems including unexplained increases or decreases in rate of seepage, cloudy appearance of seepage or presence of fines, development of new seepage areas as indicated by soft boggy areas or new or lush vegetation, and substantial unexplained fluctuation in piezometer readings.

(d) Minor slope failures including tension cracks at crest or in slopes of embankment, small bulges in slopes or in foundation near toe of slope, small depressions or sags in crest or slopes, changes in horizontal crest alignment, and gullies forming in or near the embankment or junction of the embankment and abutments.

(e) Threats of sabotage or occurrence of sabotage of noncritical project features.

(2) Emergency

Examples of conditions warranting declaration of an emergency include the following:

(a) Reservoir level is at or above the National Weather Service flood level at the control point and the reservoir level at the control point is increasing.

(b) Major seepage problems including movement of large amounts of material in existing or new seeps, pipes in embankment or foundation materials, seepage at higher elevations on downstream face of dam or perimeter dikes or in abutment areas, and substantial increases in seepage rates (especially when associated with movement of material from embankment or foundation).

(c) Major slope failures including appreciable depressions or sloughs in the crest or slopes of the dam or perimeter dikes or bulges in their slopes or their foundations, large gullies developing and continuing to erode in the embankment or at the junction of the embankment and abutments, displacement of structures or instrumentation on the dam, and continuing expansion of tension cracks after their appearance on the dam crest or slope.

(d) Threats of sabotage or sabotage to critical project features.

c. Action Upon Declaration

(a) Attend telephones as directed by the District Office. Cancel normal schedules and provide for 24-hour duty as needed.

(b) Activate appropriate portions of notification subplan.

(c) Maintain 24-hour monitoring/surveillance of situation responsible for declaration.

(d) Perform nonroutine observations and tasks as directed by the District Office.

(e) Test radio communication.

(f) Request needed assistance from the District Office to perform (a) through (e) above.

(2) Mississippi River Headwaters Project Office

(a) Monitor telephone on 24-hour basis.

(b) Place all personnel on standby for emergency duty if directed by District Office.

(c) Test radio communications.

(3) District Office

(a) Activate Emergency Operations Center.

(b) Attend telephones on a 24-hour basis.

(c) Test radio communications.

(d) Place key staff on standby for emergency duty.

(e) Provide detailed instructions to the Resource Manager for directing specific nonroutine observations and tests.

(f) Dispatch personnel to damsite as required to provide expert evaluation of situation and to assist the Resource Manager as needed.

(g) Activate appropriate portions of the notifications subplan.

A-9. Subplan Maintenance

a. Updating

This subplan shall be updated as needed by the Dam Safety Officer, including the following times:

(1) Annually.

(2) Whenever needed by modifications in instrumentation at or affecting the project, dam operating procedures, overall District emergency procedures, and/or changes of personnel.

b. Testing

The Chief, Project Operations Branch, shall annually direct a thorough inspection of all mechanical, electrical, and other equipment pertinent to conduct of this subplan. The inspection shall include all tests, servicing, and calibration necessary to ensure proper functioning.

Also, periodically, the Dam Safety Officer, in conjunction with the Emergency Management office and Dam Safety Committee, will conduct notification testing and other procedures as time and funds will alow to test the Emergency Action Plan.

c. Familiarization

The Dam Safety Officer shall ensure all pertinent Corps personnel are aware of and familiar with this subplan. Familiarization activities shall include the following:

(1) Circulate each updated version for review and signature by pertinent District staff, Mississippi Headwaters Project Office, and the Pine River Project Office.

(2) Conduct periodic review sessions with staff of the Water Control Center and Resource Manager.

(3) Brief all new Water Control Center staff within two weeks of assuming duties.

(4) Brief any new Resource Manager before assumption of duties.

TABLE A-1
INFORMATION ON KEY CONTACTS

PARTY	TELEPHONE NUMBER OFFICE	TELEPHONE NUMBER RESIDENCE	RADIO FREQUENCY	CALL LETTERS
DISTRICT PERSONNEL Resource Manager Walter Hermerding	(218)692-4488	(218)692-2118	SSB/FM	WUD640
Mississippi Headwaters Project Office James Ruyak	(218)566-2306	(218)566-1294	SSB	WUD639
St. Paul District Office				
Emergency Operations Center Twenty-four (24) hour telephone service. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving natural security, disasters, mobilization or NWS flood forecasts. Center will contact Dam Safety Officer, the Commander/District Engineer and NCD.	(218)220-0220			
District Emergency Operations Center David Christenson, Chief, Emergency Management	(612)220-0220 (612)220-0204	(612)690-5749	Contact Hastings Electronic Service Center at (612)437-2210 (call letters - WUD6)	
Natural Disaster Planner	(612)220-0204			
Project Operations Branch Responsible for identifying a person-in-charge of the preemergency or emergency situation. Must be kept informed of all preemergency or emergency situations. Also contact for matters involving normal dam operations, and/or matters not covered by other District elements. Project Operations Branch will contact Dam Safety Officers for engineering and technical assistance and keep him informed of situation.			SSB (Primary 5400Khz) 1st Alternate - 6020Khz LSB) (Emergency - 5015Khz LSB)	
Thomas Oksness, Chief, Natural Resource Management Section	(612)220-0325	(612)439-0272		
Dennis Erickson, Chief, Lock and Dam Section	(612)220-0322	(612)452-6850		
Dennis Cin, Chief, Project Operations Branch	(612)220-0320	(612)455-6786		

TABLE A-1
INFORMATION ON KEY CONTACTS (continued)

PARTY	TELEPHONE NUMBER OFFICE	RESIDENCE	RADIO CALL LETTERS
Dam Safety Officer To be informed of all pre-emergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required to resolve the pre-emergency or emergency situation.			
Robert Post, Chief, Engineering Div.	(612)220-0303	(612)437-1316	
Water Control Center For matters involving reservoir regulation. Contact if no contact is made with other elements. Call personnel in order listed until contact is made.			
Edward Eaton, Water Control Center	(612)220-0617	(612)731-9426	WUD613
Bonnie Mongtomery, Water Control Center	(612)220-0618	(612)450-0905	WUD613
Gordon Heitzman, Water Control Center	(612)220-0620	(612)429-9500	
Kelsey Willis, Water Control Center	(612)220-0619	(612)566-5022	
Helmer Johnson, Chief, Geotechnical Hydraulics & Hydrologic Engineering Branch	(612)220-0602	(612)633-7791	
Geotechnical Design Section For matters involving the structural integrity of the dam Contact if no contact is made with other elements.			
W. Grant Westall, Geotechnical Design Section	(612)220-0644	(612)455-7632	
Helmer Johnson, Chief, Geotechnical Hydraulics & Hydrologic Engineering Branch	(612)220-0602	(612)633-7791	
Design Branch For matters involving the structural integrity of the outlet structures Contact if no contact is made with other elements. Call personnel in order listed until contact is made.			

TABLE A-1
INFORMATION ON KEY CONTACTS (continued)

PARTY	TELEPHONE NUMBER OFFICE	RESIDENCE	RADIO CALL LETTERS
Thomas Sully, Chief, Struc. Engr. Section	(612)220-0511	(612)636-6812	
James Mosner, Chief, General Engr. Section	(612)220-0512	(612)735-0973	
Charles Spitzack, Chief, Design Branch	(612)220-0510	(612)645-7301	
Others			
If none of the above can be reached.			
To be called in the order listed.			
Dale Mazar, Chief, Engineering Management Branch	(612)220-0444	(612)631-1940	
Robert Whiting, Chief, Environmental Resources Branch	(612)220-0400	(612)257-4058	
Louis Kowalski, Chief, Planning Division	(612)220-0307	(612)457-6453	
Ltc. Michael Mahoney, Deputy Commander	(612)220-0301		
Col. Roger L. Baldwin, District Commander	(612)220-0300	(612)892-6410	
State of Minnesota			
Emergency	911		
Statewide Emergency Number	1-800-422-0798		
Metro Area	(612)649-5451		
Backup Only	(612)296-2100		
Crow Wing County			
Emergency Management	(218)829-1711	(218)829-9329	
Sheriff (24 hours)	(218)829-4749		
MN State Patrol (Potential Source of Assistance in Communication)	(218)828-2400 (612)482-4901		

APPENDIX B
EMERGENCY OPERATIONS AND REPAIR SUBPLAN

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PLATES

APPENDIX B
EMERGENCY OPERATIONS AND REPAIR SUBPLAN

B-1. Introduction

Conditions affecting operation of Pine River Dam could result in a hazard to life and/or property as a result of high reservoir levels or sudden release of large volumes of water. Prompt emergency operations and repairs are essential for minimizing hazards to life and property.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for emergency operations and repairs to deal with impending and existing emergencies affecting the operation and safety of Pine River Dam and Reservoir.

b. Scope

This subplan describes emergency operations and repairs to be implemented upon declaration of a preemergency or emergency. Operations and repairs are described for the following cases:

(1) Excessive seepage.

(2) Wave erosion and/or erosion of the downstream face of embankment.

(3) High reservoir level.

(4) Slope failure.

(5) Threatened sabotage.

(6) Sabotage.

c. Applicability

This subplan applies to all Corps elements and field offices concerned with operation of Pine River Dam.

B-2. Definitions

a. Preemergency

A preemergency condition is one in which some impending or existing threat to the safe operation of the dam or reservoir is identified but no significant hazard to life or property is expected. Declaration of a preemergency is internal to the Corps of Engineers and does not require notification of other parties or warnings to evacuate.

b. Emergency

An emergency condition is one in which the occurrence of a significant hazard to life and/or property is very probable or certain. Conditions justifying declaration of an emergency may be imminent or longer term. Declaration of an emergency requires notification of key personnel and issuance of warnings to evacuate potentially hazardous areas.

c. Resource Manager

The term Resource Manager means the individual in charge at the Pine River Dam and Reservoir project site.

d. Mississippi Headwaters Project Office

The term Mississippi Headwaters Project Office means the person in charge of the Mississippi Headwaters Project Office.

e. District

The term District means one of the following elements depending on which is appropriate for the situation at hand.

(1) Dam Safety Officer. The Dam Safety Officer must be kept informed of all preemergency or emergency situations. The Dam Safety Officer is responsible for identifying and/or providing the necessary engineering or technical support required for the preemergency or emergency. The Dam Safety Officer is also responsible for keeping the Dam Safety Committee and the NCD Dam Safety Officer informed of the preemergency or emergency.

(2) Project Operations Branch. The Project Operations Branch is responsible for identifying a person-in-charge of the preemergency or emergency and for keeping the Dam Safety Officer informed of the preemergency or emergency. It is also responsible for matters involving normal dam operations and/or other matters not covered by the other District elements.

(3) Emergency Operations Center. The Emergency Operations Center provides 24-hour telephone contact with the District Office and is responsible for keeping the Dam Safety Officer, the Commander/District Engineer, and NCD in contact with the operations and personnel. It is also responsible for matters involving national security, disasters, and mobilization.

(4) Water Control Center. The Water Control Center is part of Hydrology section in Geotechnical, Hydraulics and Hydrologic Engineering Branch and is responsible for matters involving reservoir regulation. The Water Control Center collects and monitors hydrometorological data and provides discharge information to the Resource Manager.

(5) Geotechnical Design Section. The Geotechnical Design Section is a section in Geotechnical, Hydraulics, and Hydrologic Engineering Branch and is responsible for matters involving the structural integrity of the dam.

(6) Design Branch. Design Branch is responsible for matters involving the structural integrity of the outlet structures.

(7) Project Management Branch. Project Management Branch is responsible for management support.

(8) Planning Division. Planning Division is responsible for management support and matters involving environmental analysis and cultural resources.

B-3. Basis of Activation

This subplan is to be activated immediately upon declaration of a preemergency or emergency. See appendix A, Emergency Identification Subplan, for procedure of declaring a preemergency or emergency.

B-4. Responsibilities

a. Resource Manager

(1) Provide information to District on existing problem severity and rate of change.

(2) Request needed assistance from the District including the following:

(a) Personnel, including expert supervision.

(b) Equipment.

(c) Materials.

(3) Carry out operations and repairs as directed by the District.

(4) Act independently to implement emergency operations and repairs if communications with the District are disrupted or immediate action is required including the following:

(a) Deciding the urgency of correction.

(b) Carrying out appropriate portions of the emergency operations and repairs subplan.

(c) Obtaining needed personnel, equipment, and materials.

b. Mississippi Headwaters Project Office

(1) Provide personnel, equipment and materials to Resource Manager or as directed by the District.

(2) Direct emergency operations and repairs if communications between the Resource Manager and District are disrupted.

c. District

(1) Assess problem and Resource Manager's request for assistance with respect to the following:

(a) Urgency for correction.

(b) Type of corrective actions required.

(c) Personnel required for corrective actions including requirements for expert advice and/or on-site supervision.

(d) Equipment and materials required for corrective actions.

(2) Provide direction to the Resource Manager on emergency operations and repairs to be carried out.

(3) Dispatch needed personnel, equipment, and materials to the project from the District.

(4) Arrange needed personnel, equipment, and materials from sources other than District.

B-5. Emergency Operations and Repairs - Excessive Seepage

a. Potential Problems

Abnormal seepage may occur as boils in the main embankment, perimeter dikes or their foundations and abutments; new seep areas on the downstream face of the main embankment, perimeter dikes, or their foundations and abutments; or new seep areas immediately downstream of the main embankment, perimeter dikes, or outlet structure. Seepage high on the face of the main embankment or perimeter dikes, large amounts of seepage, and seepage carrying fines are especially serious. Excessive seepage problems are most likely to occur when the reservoir water level is at higher than normal elevation.

b. Corrective Action

Individual boils or small areas of seepage can be controlled on a temporary basis by ringing them with sandbags or other materials. Longer term control and control of large areas of seepage can be effected by covering the area with a 3- to 5-foot-deep layer of granular material graded from coarse sands at the bottom to coarse gravels at the top. Lowering of the reservoir pool level reduces pressure on seepage areas and aids in control.

(1) Solutions to Combat Sand Boils

A sand boil may gradually undermine a dam or dike and result in a failure by causing settlement and sloughing. As long as the flow is steady and not increasing and no material is being carried, the danger is relatively small. In times of forecasted high water, all locations of prior boils and any newly developed boils should be watched closely, especially those on the embankment or within 100 feet of the toe of the embankment. All boils should be conspicuously flagged so that patrols can locate them without difficultv and observe changes in their conditions. A sand boil that discharges clear water in a steady flow is usually not dangerous to the safety of the dam. The only action necessary in this case is to drain the excess water to prevent it from standing near the dam. However, if the flow of water increases and the sand boil begins to discharge material, corrective action should be undertaken immediately.

A common method of handling sand boils involves walling up a watertight sack ring around the boil until the water in the ring has attained sufficient head to counteract the head causing the boil. This is shown graphically on plate B-1. Ringing boils with steel piling is shown on plate B-2. It is not necessary or desirable to check the flow of water completely, because this may cause other boils to break out in the vicinity. It is necessary, however, to reduce the velocity of flow and to stabilize the movement of sand, silt, and other materials through which the water stream passes. A boil at the toe of the embankment is not necessarily more dangerous than one at a considerable distance landward from the toe.

(2) Solutions to Combat Seepage

Remedial measures to combat excessive embankment seepage may be performed on either the upstream or downstream slopes.

(a) Downstream remedial work should allow the seepage water to flow as freely as possible while preventing migration or loss of existing soil materials from the embankment or foundation. If seepage causes sloughing of the landward slope, it should be flattened to a 1V on 5H slope or flatter. Because seepage on a slope indicates effective pervious embankment behavior or worse, material for flattening must be more pervious than the embankment material.

(b) The upstream treatment, when the seepage is heavy or the embankment shows signs of sloughing, would consist of banking or sandbagging the area under the pool with additional earth or other materials. This would minimize the entry of water into the foundation and/or the embankment.

(c) When water seeps through a foundation or embankment, material may be carried along with it, causing sink holes to appear in the embankment. These holes should be filled with sandbags or earthen material as soon as possible.

c. Resources Required

(1) Resources Required for Combating Seepage (Placing Granular Blanket)

(a) Materials

The characteristic of sand and gravel mixture to allow the passage of water while at the same time preventing the passage of soil grains is used extensively in the design of water retaining structures. The properties of resistance to displacement by flowing water, resistance to wear from vehicular traffic, and the maintenance of strength and limited volume change over a large range of water contents make sand and gravel useful in providing surface protection to dams and canal banks. The wide range in gradation possible in sand and gravel mixtures, together with the wide range in structural materials to be protected, results in a wide range of acceptability for the materials used for sand and gravel or crushed rock blankets. The engineering properties and uses for various soil types are listed on plates B-8 and B-9.

Natural sand and gravel deposits normally contain excessive amounts of sand. However, if these materials are clean (contain less than 5 percent fines), almost any sand and gravel mixture can be used for downstream drainage blankets for earth dams by thickening the pervious blanket sufficiently so that seepage through the embankment and foundation can be carried within the blanket section. For some cases involving seepage through the foundation, it can be shown that the effective weight of the blanket must be equivalent to or greater than the total head to prevent rupturing boils or piping. Sometimes only 50 to 75 percent of the total head is required for effective weight of the blanket. For the pervious blankets between riprap and rolled earthfill, the requirements for the sand and gravel material become less critical as the thickness of the riprap layer increases. Generally, material from a natural deposit can be used if at least 50 percent of the material is in the gravel size range when riprap blankets of 3-foot normal thickness are specified. In those ranges of reservoir operation where anticipated wave action is comparatively rare, some relaxation of material requirement is also possible.

(b) Equipment

Placement of granular blankets requires the following equipment:

(i) Dump trucks for transportation of materials to point of placement. The number of trucks required depends on the haul time and desired time of completion.

(ii) Tractors with blades for grading and/or backhoes or draglines. One tractor is usually capable of grading up to about 500 square feet per hour. The capacity of backhoes and draglines varies widely.

(iii) Shovels and rakes for hand placement of materials.

(c) Personnel

In addition to drivers for trucks and other mechanized equipment, labor is required for other tasks. The number of personnel required for this purpose depends on the size of the area being treated and desired speed of completion. Labor requirements for various tasks can be approximated from tables B-1, B-2, and B-3 and plate B-3.

(2) Resources Required for Ringing Boils

(a) Materials

Materials required for ringing boils include the following:

(i) Sandbags.

(ii) Sand.

(b) Equipment

Shovels are the only equipment required for ringing small boils. For larger areas of seepage, consideration should be given to use of a granular blanket. If larger areas must be treated by sandbagging, consideration should be given to use of concrete trucks, front end loaders, or other mechanized equipment to fill and move bags. Typical sections for ringing boils are shown on plates B-1 and B-2.

(c) Personnel

Curves to estimate the time (in hours) needed to place sandbags to construct various sizes of sandbag rings under various conditions are on plate B-3.

(3) Lowering of Reservoir Pool Level

(See Section B-8.b.)

d. Technical Directions

(1) Placing Granular Blanket

A requirement of all blankets is careful placement. Requirements may vary widely according to type and location of the blanket placement, but in every case uniformity and thickness are very important. (For additional information see Earth Manual, reference 20.) Blankets may be placed by the following methods:

(a) Using mobile dragline machines or backhoes. Material may be obtained from the borrow pit, placed in trucks, hauled to the dam and dumped on the dam crest or abutments. The blanket may be placed using a dragline or backhoe. Dozers can be used to push the material from the crest or the abutments. The blanket should extend well above, below, and to both sides of the affected area and the material should be distributed as evenly as practical on both the downstream slope and berm.

(b) Shoveling material by hand from trucks unloaded on the dam crest.

Great care should be taken so that equipment loading does not cause failure of the dam.

(2) Ringing Boils

(a) Multiple nearby boils or soft areas adjacent to boils should be included in the sandbag ring.

(b) Build the ring only high enough to slow water flow to the point that no fines are carried. Do not completely shut off the flow of seepage.

(c) The base of the sandbag ring should be at least one and one-half half times the contemplated height. Typical sections for ringing boils are shown on plates B-1 and B-2.

(3) Sandbags

Procedures for filling, handling, and placing sandbags are presented in section B-6.

B-6. Emergency Operations and Repairs - Wave Damage and/or Erosion of the Downstream Face of the Embankment

a. Potential Problems

Wave damage may occur during a period of high winds at the dam and reservoir. Damage may include displacement of riprap and/or erosion of the underlying materials causing collapse of the riprap. Wave damage is particularly serious during abnormally high reservoir pool levels when damaging erosion can cause a sudden collapse of the crest with subsequent overtopping of the embankment. Wash is erosion of the upstream slope of the dam or perimeter dikes by wave action. This action may be caused by storms and shore winds and may be particularly dangerous on open reaches where the slope is not protected by riprap or timber and brush screens. Sand slopes and unsodded slopes are much more susceptible to wave wash than well-sodded slopes. Wave action may seriously damage a dam, particularly if the water surface is near the dam crest, if the reservoir pool is constant for a relatively long period of time, or if a slope is newly constructed or of sandy soil. Although the necessity for wave action protection cannot always be

foreseen, the probable spots where wave wash might occur as known from observations will give a good idea of where material and supplies should be concentrated. Upon discovery of a damaged wave wash section or the beginning of wave wash damage, action should be taken to prevent further damage.

b. Corrective Action

The type of corrective action that is appropriate depends on the severity of damage, rate of progression of damage, and urgency of action. Temporary protection above and within 10 to 12 feet of the waterline can be provided quickly by use of plywood or canvas or polyethylene sheets or by filling the eroded area with sandbags. Placement of polyethylene sheets is illustrated on plate B-4. Protection farther below the water level can be provided by dumping riprap in the affected area. A strip of cotton or burlap bag over the affected area weighted down by sandbags is very effective in combating erosion. Sack revetment and construction of sandbag barriers are illustrated on plates B-5 and B-6, respectively. In cases of severe erosion, lowering of the reservoir pool level can shift wave forces to a lower elevation. Repairs normally require reconstruction of the eroded slope and replacement of both bedding materials and riprap. Lowering of the pool is usually required to make permanent repairs.

c. Resources Required

(1) Temporary protection with plywood

(a) Materials

(i) 1/2-inch exterior plywood.

(ii) Concrete blocks or sandbags for use as weights.

(iii) Stakes (2 inches by 4 inches by 3 feet).

(iv) 12-gauge galvanized tie wire.

(v) Tie cord.

(b) Equipment

(i) Sledge hammers.

(ii) Wire cutters.

(iii) Pike poles.

(iv) Shovels.

(v) Drill, 1/4-inch.

(c) Personnel

The number of personnel required to put various areas of protection in place using plywood can be approximated from plate B-7.

(2) Temporary Protection with Canvas

(a) Materials

(i) Wavewash canvas, 7 feet wide.

(ii) Stakes (2 inches by 4 inches by 3 feet).

(iii) 1 1/2-inch pipe for bottom stiffener (20-foot lengths)

(iv) Concrete blocks or sandbags for use as weights.

(v) 12-gauge galvanized tie wire.

(b) Equipment

(i) Sledge hammers.

(ii) Wire cutters.

(iii) Pike poles.

(iv) Shovels.

(c) Personnel

The number of personnel required to put various areas of temporary wave protection in place using canvas can be approximated by making assumptions using plate B-7.

(3) Temporary Protection with Sandbags

(a) Materials

(i) Sand.

(ii) Sandbags.

(b) Equipment

(i) Sack racks and stabilizing pins.

(ii) Shovels.

(iii) Concrete transit trucks.

(iv) Other trucks.

(v) Wheelbarrows.

(c) Personnel

The number of personnel required to fill and place sandbags can be approximated by assuming that under average conditions with a crew of 2 to 10 workers and 1 crew leader it would take 4 hours to place 1 cubic yard by hand at the place of filling. Also, see plate B-3.

d. Technical Directions

The construction of emergency protection projects depends on local working conditions, resources available, and the methods employed. The most efficient system of either mechanical or manual means of construction should be selected to meet the criteria of the emergency.

(1) Manual Labor

Manual labor can be a very effective way of accomplishing the necessary emergency tasks. Availability of a large work force or conditions that restrict the use of vehicles and/or mechanical devices are examples of situations that lend themselves to the use of manual labor. The availability, need, and use of manual labor should be carefully considered ahead of time. Resources should be identified so that they can be quickly mobilized for an emergency.

(a) Sacking Operations

Sacks filled with earth material are suitable for almost every phase of emergency high water protection work. In many instances, sacks provide the most practical and effective emergency deterrent. However, the labor force required (plate B-3); duration of placement; and cost, including purchase, filling, handling and removal should be considered, with discretion exercised so that the application of sacks is advantageous when compared to other methods.

(i) Filling Sacks

(aa) For seepage and sand boil control, a completely filled sack is detrimental. Instead, a half-filled sack should be used.

(bb) For wave erosion protection, the sacks should be well filled and the material shaken down into the sack, but not tamped. A well-filled sack will measure approximately 12 inches by 24 inches by 8 inches and will contain 1 1/3 cubic feet of material, weighing about 130 pounds. Sacks for wave erosion protection should be sewn shut at the top.

(cc) The top of each sack can be loose, tied, or sewn depending on the proposed use. If large curved steel needles are not readily available for sewing the sacks, suitable needles can be made out of almost any kind of wood. The wooden needle should be about 7 inches long, whittled down to a diameter that will permit passage through the sack material

- about 1/4 inch to 5/8 inch - with a large eye cut in one end and a point on the other. Any heavy twine is suitable for sewing the sacks.

(dd) When it is necessary to fill a large number of sacks in a short period of time, a sack rack should be used. One type of sack rack can be made by driving three stakes in the ground with their tops above the ground to the approximate height of the sack.

(ii) Transporting Sacks

Sacked material may be transported around the site in wheelbarrows, in handbarrows, or on people's shoulders.

(aa) Wheelbarrows are preferred because two filled sacks constitute a load for one wheelbarrow, which can be handled by one person if smooth-run planks and a suitable grade are provided.

(bb) When necessary, filled sacks are transported on a person's shoulders, one sack per person.

(cc) Handbarrows, carried by two people, can be used to transport two-sack loads over longer distances. A handbarrow may be made of two hand bars and two sacks. The hand bars are two poles about 5 feet long, from 1-1/2 inch to 2 inches in diameter. Any local wood that has sufficient strength is suitable. The handbarrow is assembled by slipping the hand bars through the bottom corners of an empty sack, taking care not to slit the openings in the sack larger than necessary. The second sack is slipped on a similar manner, but in the reverse direction so that one sack is telescoped into the other. The sacks should be securely fastened to the hand bars by small nails.

(dd) Under certain situations, consideration should be given to filling sacks off-site and transporting them to the problem area by truck or perhaps on pads flown to the spot by cargo type helicopters. Where vehicles must be sent over roads that are impassable because of mud or sand, their safe passage may be provided by the use of a plank road.

(2) Mechanical Methods

If an emergency project is large and/or must be completed quickly, consideration should be given to the use of mechanical methods. They offer a versatile and effective way to construct emergency works in situations that have urgent time requirements.

(a) Mechanical Methods for Sacking

Sacking operations can be accelerated with the use of mechanical equipment. A small trenching machine can dig material and discharge it to the side. Another scheme would be to use a small dragline and combination hopper-belt conveyer so that sacks could be filled directly on trucks with a minimum of laborers required.

(b) Mechanical Tools to Speed Up Production

If conditions warrant, electric saws, air hammers, etc., could be used to speed up the mass production of such articles as cribs, board sections of movable wavewash protection, and other earth retaining structures.

(c) Use and Planning of Mechanical Methods

The use of mechanical equipment calls for innovative and immediate decisions to ensure that the required emergency protective works are constructed as quickly as possible.

Repair procedures and where to obtain heavy equipment, tools, materials, and other resources should be given serious thought and action during nonflood seasons so that they can be carried out in the most efficient manner possible.

B-7. Emergency Operations and Repairs - Abutment, Foundation, or Embankment Failure

During periods of above normal pool, the abutments, foundation, and embankment should by inspected closely. Also, after periods of high pool, a close inspection should be made to assess significant changes in these features. Notification of any potential preemergency or emergency conditions should be immediately made following the guidance in appendix C.

B-8. Emergency Operations and Repairs - High Reservoir Level

a. Potential Problems

High reservoir levels cause large hydrostatic forces on the dam and perimeter dikes, reduce freeboard available to contain wave action, and reduce the capability of the dam and perimeter dikes to impound major inflows without overtopping or uncontrolled spillway flow. High reservoir levels contribute to excessive seepage, piping, wave erosion, and other safety problems. High water levels can also damage property and create safety problems around the periphery of the reservoir.

b. Corrective Action

The only corrective action for high water levels is increasing releases. Discharge is governed by damage within the reservoir and downstream conditions. The Reservoir Regulation Manual (reference 9), gives guidance concerning reservoir releases. Beginning about 1 September, releases will be made so that Pine River Reservoir will be drawn down to its spring elevation of 1227.32 feet as early as 15 February but no later than 1 March. After the spring high water, releases from Pine River Dam may be made as necessary to lower the reservoir to the desirable elevation (1229.32 feet) by 1 June. Rainfall greater than 1.5 inches in the reservoir area should be immediately reported to Water Control personnel. If attempts to make contact with the District Office should fail, the Resource Manager will follow the release schedule outlined below until contact can be made.

Discharge schedule

*Pool elevation	Increase current discharge by
1229.6 feet	200 cfs
1229.7 feet	300 cfs
1229.8 feet	400 cfs
1229.9 feet	500 cfs
1230.0 feet	1,000 cfs

Notes:
1. Total discharge not to exceed 2,500 cfs
2. Gate openings should be made at least 4 hours apart

*Wind, especially wind out of the north or west, can drastically affect pool elevations and must be accounted for. Subtract 0.1 foot from the pool elevation for every 10 mph (miles per hour) of wind coming from the north or west.

If the elevation of Pine River Reservoir exceeds 1231.32 feet, the dam must be completely opened and open river conditions will exist until the pool drops below the maximum regulating limit and regulatory control at the dam is again possible.

B-9. Emergency Operations and Repairs - Slope Failure

a. Potential Problems

Slope failure may occur as the mass movement of a portion of the embankment. Such failures weaken the dam, and, if located sufficiently high on the embankment, may cause a breach or lead to collapse of the dam crest. Slope failures of any significant magnitude are serious and require immediate corrective action and notification of proper personnel according to appendix C.

b. Corrective Action

(1) Lowering of the upstream pool should be done for any slope failure that is sufficiently serious to threaten the safety of the dam or dike areas. (See Reservoir Regulation Manual, reference 9.)

(2) Immediate treatment of slope failures consists of filling slide areas with riprap, sandbags, or a granular blanket. The preferred method depends on materials and labor available and the urgency of action. When the urgency of the situation permits, filling of slide areas will be carried out under supervision of District staff and constitute rebuilding of the affected portion of the embankment. Immediate treatment in urgent situations will consist of filling slide areas with sandbags, riprap, or other available materials. The methods used would be the same as those discussed in section B-5 and B-6.

B-10. Emergency Operations and Repairs - Threatened Sabotage

a. Potential Problems

Threats of sabotage are most likely to be received from individuals or groups whose actual intent of carrying through with the threatened action is not known. However, all such threats are to be taken seriously. Threats considered most probable to occur are those related to disruption of communications, blocking of access to the project, and interference with project operations. Threats could also relate to damaging the embankment or other key project features affecting safety.

b. Corrective Action

(1) All threats concerning the Pine River Dam and Reservoir will be reported immediately to the Federal Bureau of Investigation and to the District's Geotechnical, Hydraulic and Hydrologic Engineering Branch. Others should be notified according to appendix C.

(2) Immediate assistance to secure and protect the dam, dikes, and appurtenant facilities will be requested if threatened action could jeopardize the safety of project visitors and staff or downstream areas. Agencies from which law enforcement assistance can be obtained are listed in table C-2.

(3) Every effort should be made to operate the Pine River Dam to avoid injury to all parties. However, possible catastrophic consequences of dam failure require that actions necessary to maintain the safety of the dam must not be compromised by persons seeking to block access to the site, limit reservoir levels or releases, or otherwise impede essential operations.

B-11. Emergency Operations and Repairs - Sabotage

a. Potential Problems

Acts of sabotage may range from minor disruptions to quasi-military attacks by knowledgeable and well-equipped professionals. The effects of sabotage fall into one of three categories: (1) not affecting safety of the dam; (2) posing a minor or future safety problem; or (3) posing an immediate, serious safety problem.

b. Corrective Actions

(1) All acts of sabotage will be reported immediately to the Federal Bureau of Investigation and to the District's Geotechnical, Hydraulic and Hydrologic Engineering Branch.

(2) Immediate remedial action shall be initiated in all cases of sabotage causing an imminent or future safety problem of a serious nature. As appropriate, remedial action shall include:

(a) Declaration of an emergency condition and activation of the notification subplan (appendix C).

(b) Activation of the emergency drawdown.

(c) Initiation of emergency repairs according to the nature of damage.

B-12. Inventory of Resources

Resources available at the District level for carrying out emergency operations and repairs are listed in table B-4. An inventory of available contractors and vendors at the Project Office level is given in table B-5. An inventory of available resources at the Project Office is given in table B-6.

Table B-1 - Emergency labor requirements - earthfill structures (1)

Work Element	Unit	Worker - days per unit: Adverse condition	Average condition	Favorable condition
Excavate and load	1000 CY	11.2	6.9	2.5
Haul	1000 CY MI	5.2	3.1	1.4
Spread and Compact	1000 CY	18	9	4
Erosion Control: Riprap (12 inches thick)	1000 CY	22.85	15.0	7.5
For quick estimates: Earthfill structure, complete (2)	1000 CY	54	35	15

Typical crews: 1 crew leader, 3 to 5 laborers plus equipment for clearing and grubbing; 1 worker with equipment excavating and loading; 5 to 15 workers with equipment hauling; 1 crew leader and 3 to 7 laborers spreading and compacting fill; 1 crew leader and 5 to 10 laborers installing erosion control plus equipment and workers hauling materials.

(1) Reference - FM 5-35, table 16-21, as quoted in references 15 and 22.
(2) Includes all clearing, borrowing, hauling, compacting, and erosion control.

Table B-2 - Emergency labor requirements - erosion control (1)

Work Element	Unit	Worker - days per unit		
		Adverse condition	Average condition	Favorable condition
Machine work:				
Sloping shoulders, banks and ditches	1000 SY	4.0	2.6	1.3
Hauling riprap or rubble	1000 CY MI	5.2	3.1	1.4
Placing riprap or rubble (12 inches thick)	1000 CY	18	12	6
Handwork:				
Sloping shoulders banks and ditches	1000 SY	33	22	11
Placing riprap or rubble	SY	0.09	0.06	0.03
For quick estimates:				
erosion control - riprap (12 inches thick)	1000 SY	22.5	15.0	7.5

Typical crew: Sloping shoulders, banks and ditches - 1 to 2 operators on equipment, or 1 crew leader and 3 to 8 laborers with hand tools.

Typical crew: Riprap - 1 crew leader and 6 to 20 laborers hauling and placing riprap.

(1) Reference - FM 5-35, table 16-42, as quoted in references 15 and 22.

Table B-3 - Emergency labor requirements - general excavation (1)

Work Element	Unit	Worker - days per unit: Adverse condition	Average condition	Favorable condition
Machine work:				
Excavating (no trim nor handwork)	1000 CY	25	12	6
Loading	1000 CY	9.0	4.5	2.0
Hauling	1000 CY MI	5.2	3.1	1.4
Spreading	1000 CY	4.9	3.0	1.5
Backfilling	1000 CY	9	6	3
Compacting	1000 CY	12	8	4
Grading	1000 CY	1.6	0.8	0.4
Handwork:				
Excavating	CY	1.2	0.7	0.3
Loading	CY	0.8	0.4	0.2
Spreading	CY	0.18	0.12	0.06
Backfilling	CY	0.35	0.20	0.10
Compacting	CY	0.35	0.35	0.15
Shoring walls of excavating	1000 SF	40	24	8

Typical crew: Machine work - 1 crew leader, 2 operators excavating, 2 to 6 operators on hauling equipment, 1 operator on spreading and backfilling equipment; 1 operator or compacting equipment, and 1 operator on grading equipment.

Typical crew: Handwork - 1 crew leader, 2 to 10 workers excavating, loading, spreading, backfilling, compacting, trimming, and fine grading.

Typical crew: Shoring - 2 or more workers.

(1) Reference - FM 5-35, Table 16-20, as quoted in references 15 and 22.

Table B-4 - Inventory of resources - District level

Name of Resource	Type of Resource	Address	Phone Number
Brisson Pump Company	Pump distributor	2359 E. Cowern Place N. St. Paul, MN 55109	(612) 777-3317
Tecumseh Products Company	Pump distributor	P.O. Box 355 223 Curtis Street Delaware, OH 43015	(614) 369-9656
Kasten Schmidt Equipment Systems	Pump distributor	455 Whitrock Avenue Wisconsin Rapids, WI 54494	(715) 423-9221
The Crisafulli Pump Company, Inc.	Pump distributor	Box 1051 Glendive, MT 59330	(406) 365-3393
Gator Pump, Inc.	Pump distributor	P.O. Box 57 302 Corrigan Brownwood, TX 76801	1-800-351-1463
Cherne Industries, Inc.	Sewer plugs/ pipe stoppers	5710 S. County Road 18 Minneapolis, MN 55436	(612) 933-5501
NB Products	Sewer plugs/ pipe stoppers	35 Bevlah Road New Britain, PA 18901	(215) 345-1879
Goodyear Tire and Rubber Company	Sewer plugs/ pipe stoppers	5100 West 35th Street Minneapolis, MN 55416	(612) 927-7381
Carlson Equipment Company	Sewer plugs/ pipe stoppers	1380 W. County Road C St. Paul, MN 55113	(612) 633-8171
Mac Katz Bag Co., Inc. (includes polyethylene sheeting)	Sandbags	P.O. Box 1666 Indianapolis, IN 46206-1666	(317) 635-9561
Berg Bag Company	Sandbags	410 3rd Avenue North Minneapolis, MN 55401	(612) 332-8845 (612) 922-3286 (after hours)
Volm Bag Company	Sandbags	2200 Mary Hills Drive Golden Valley, MN 55345	(612) 935-8222
Central Bag Company	Sandbags	1323 W. 13th St. P.O. Box 4044 Kansas City, MO 64101	(816) 471-0388
Dan-Dee Equipment, Inc.	Sandbagging Equipment	P.O. Box 125 Honey Creek, WI 53138	(414) 534-3138

Table B-4 - Inventory of resources - District level (continued)

Name of Resource	Type of Resource	Address	Phone Number
Bemis Company, Inc. Packaging Service	Sandbagging Equipment	315 27th Avenue N.E. Minneapolis, MN 55418	(612) 782-1200

Table B-5 - Inventory of local contractors and vendors - project office level

Name of Contractor	Type of Service	Address/Phone Number
Casper Construction Co., Inc.	Contractor	212 Southeast 10th Street Grand Rapids, Minnesota 55744 (218) 326-9637
Hawkinson Construction Co., Inc.	Contractor	1714 Northwest 3rd Street Grand Rapids, Minnesota 55744 (218) 326-3569
Eagle Contracting Co.	Contractor	Remer, Minnesota 56672 (218) 566-1454
Peterson Excavating, Inc.	Excavation	Federal Dam, Minnesota 56641 (218) 654-5282
C&D Excavating	Excavation	Rt. 3 Box 174 Pequot Lakes, Minnesota 56472 (218) 568-5009
Harold & Sons	Contractor	Highway 317 North Brainerd, Minnesota 56401 (218) 829-7866 (218) 829-3382 (218) 963-3177 (after hours)
Roberts Sand and Gravel	Contractor	1701 Emma Brainerd, Minnesota 56401 (218) 829-2952 (218) 829-4861 (after hours)
Smilich Enterprises	Excavation	RR 1 Bay Lake Deerwood, Minnesota 55444 (218) 678-2939
Smitty's Excavation	Excavation	RR2 Box 140A Aitkin, Minnesota 56431 (218) 678-2910
Sullivan JJ & Sons, Inc.	Excavation	Aitkin, Minnesota 56431 (218) 927-2318
Wannebo Excavating, Inc.	Excavation	Pine River, Minnesota 56474 (218) 543-4780
Lyle Arends	Contractor	H.C. 83 Box 1148 Cross Lake, Minnesota 56422 (218) 692-4433
Perkins Excavating	Excavation	HC 83 Box 28 Cross Lake, Minnesota 56422 (218) 692-2156

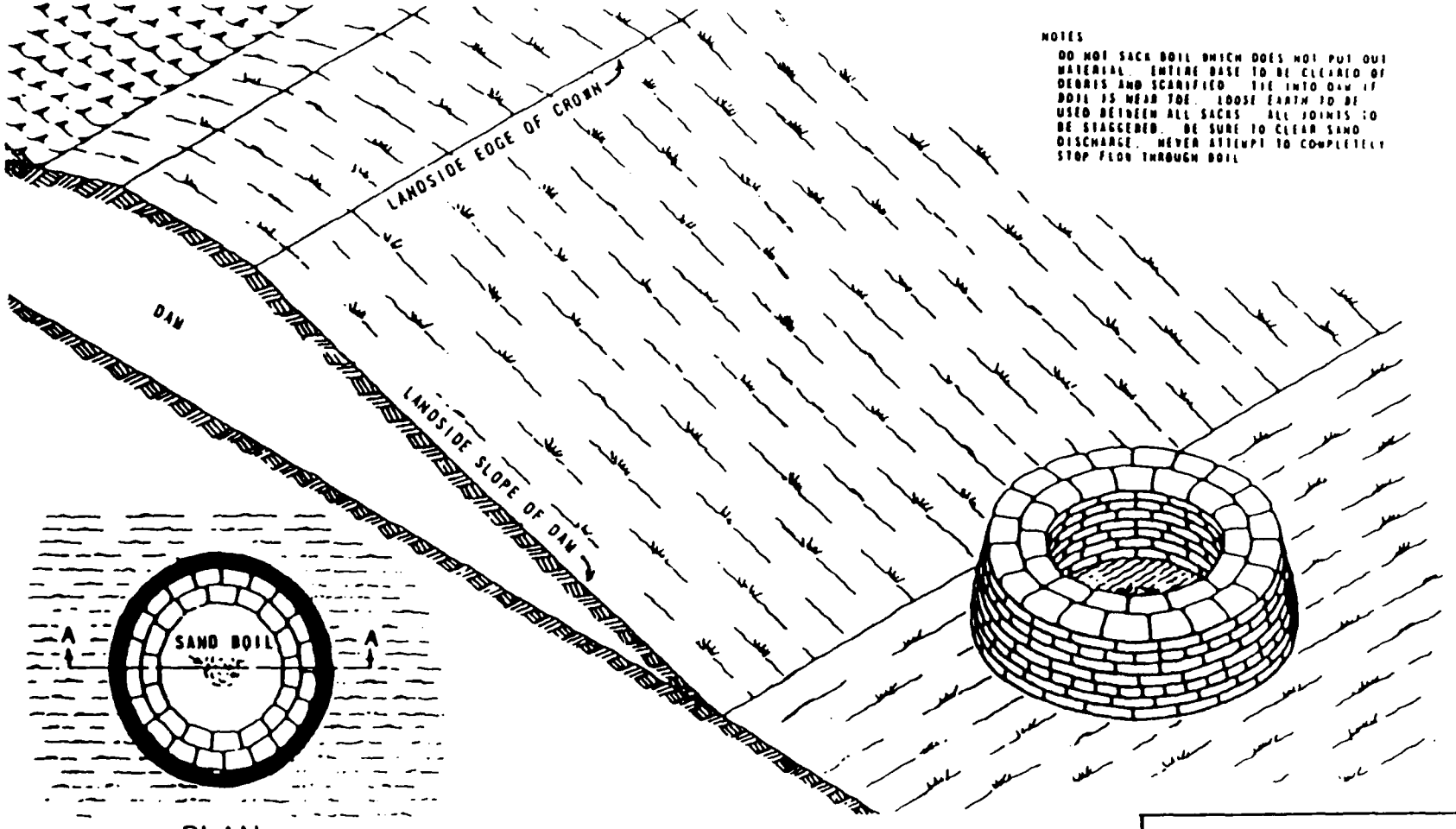
Table B-6 - Inventory of resources at Pine River project office

Equipment

Tractor, Gas, John Deere w/bucket & blade
Truck, 2 ton, Ford Dump flat bed
Truck, 3/4 ton, Dodge, FWD Pickup w/FM radio
Pump, Water 92 GPM Homelite Portable
Generator, Gas, Kohler 3W, Portable
Generator, Gas, Onan 15KW, Trailer mounted
Radio, FM Portable 4 each
Base Station, Motorola
Chainsaws, McCulloch and Homelite
Concrete saw
Welder, 240V, Miller portable
Boat with trailer, 16' Alumacraft
Boat with trailer, 20' Kayot
Outboard Motor, 9.8 HP Mercury
Outboard Motor, 85 HP Johnson

Supplies

Sandbags, 350 each
Poly, 1 roll



NOTES

DO NOT SACK BOIL WHICH DOES NOT PUT OUT MATERIAL. ENTIRE BASE TO BE CLEARED OF DEBRIS AND SCARIFIED. TIE INTO DAM IF BOIL IS NEAR TOE. LOOSE EARTH TO BE USED BETWEEN ALL SACKS. ALL JOINTS TO BE STAGGERED. BE SURE TO CLEAR SAND DISCHARGE. NEVER ATTEMPT TO COMPLETELY STOP FLOW THROUGH BOIL

PLAN

HEIGHT SHOULD BE ONLY SUFFICIENT TO CREATE ENOUGH HEAD TO SLOB DOWN FLOW THROUGH BOIL SO THAT NO MORE MATERIAL IS DISPLACED AND BOIL RUNS CLEAR

SECTION A-A

SCALE 1/8" = 1'-0"

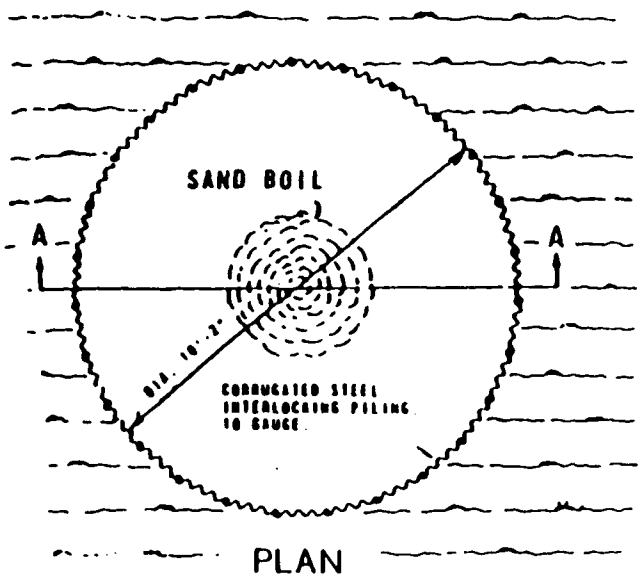
RINGING SAND BOILS WITH SACKED EARTH

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

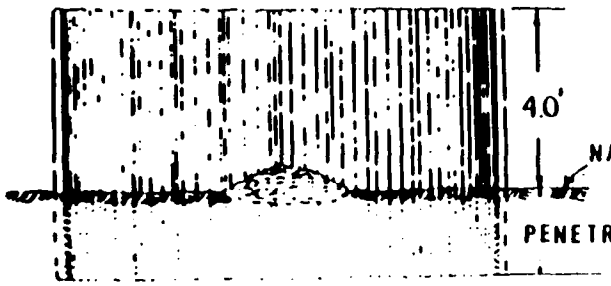
PLATE B-1

NOTE

DRIVING CAPS WILL BE USED. DRIVING MAY BE EFFECTED EITHER BY MECHANICAL OR HAND METHOD.



PLAN



SECTION A-A

NOTES

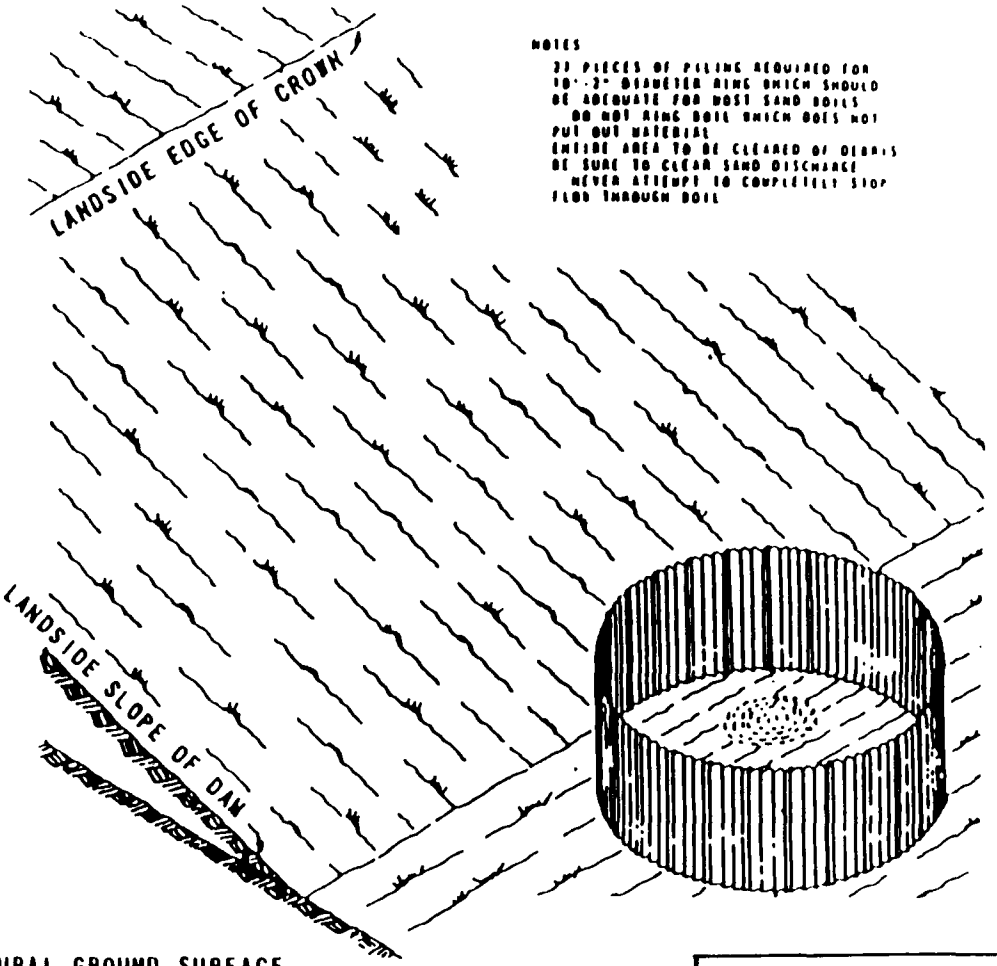
33 PIECES OF PILING REQUIRED FOR 10'-2" DIAMETER RING WHICH SHOULD BE ADEQUATE FOR MOST SAND BOILS

DO NOT RING BOIL WHICH DOES NOT PUT OUT MATERIAL

ENTIRE AREA TO BE CLEARED OF DEBRIS

BE SURE TO CLEAR SAND DISCHARGE

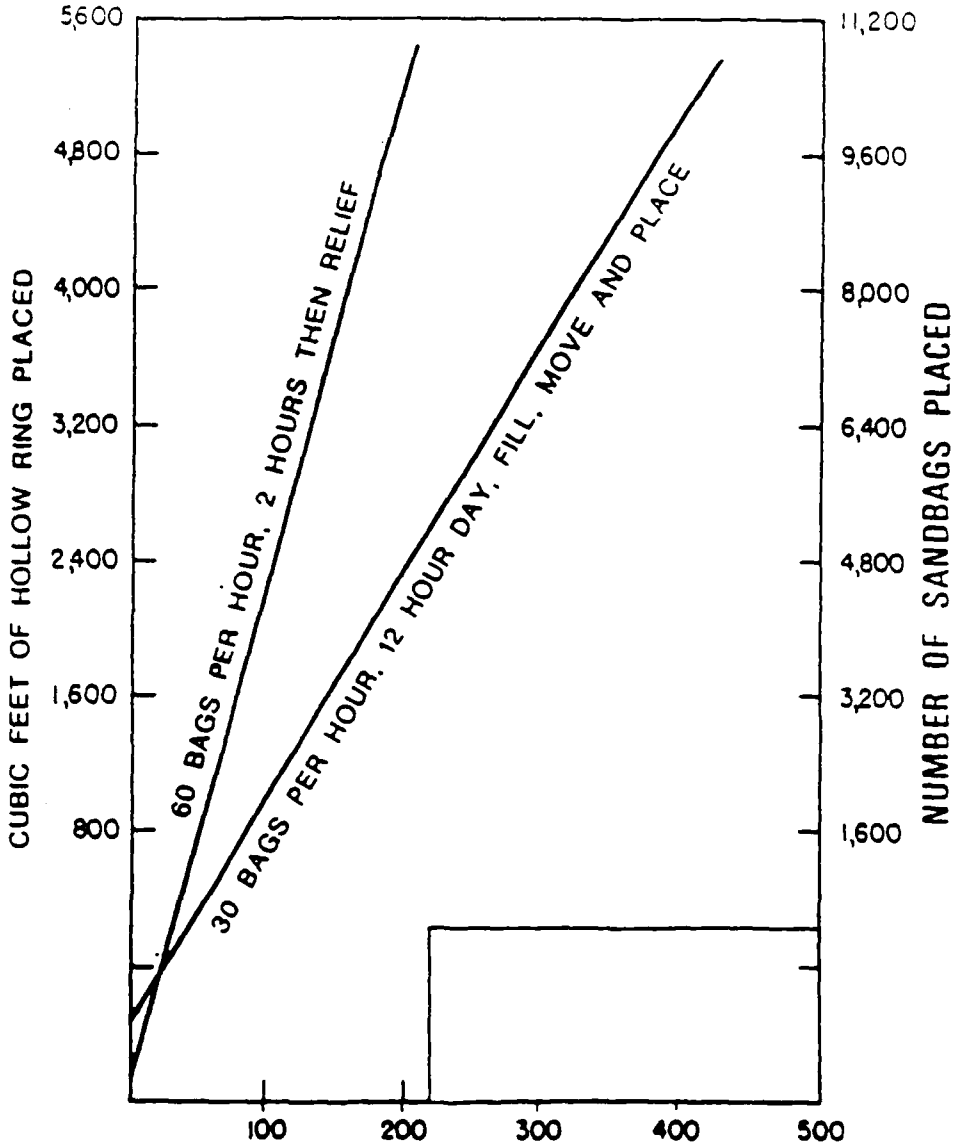
NEVER ATTEMPT TO COMPLETELY STOP FLOW THROUGH BOIL



RINGING SAND BOILS WITH STEEL PILING

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

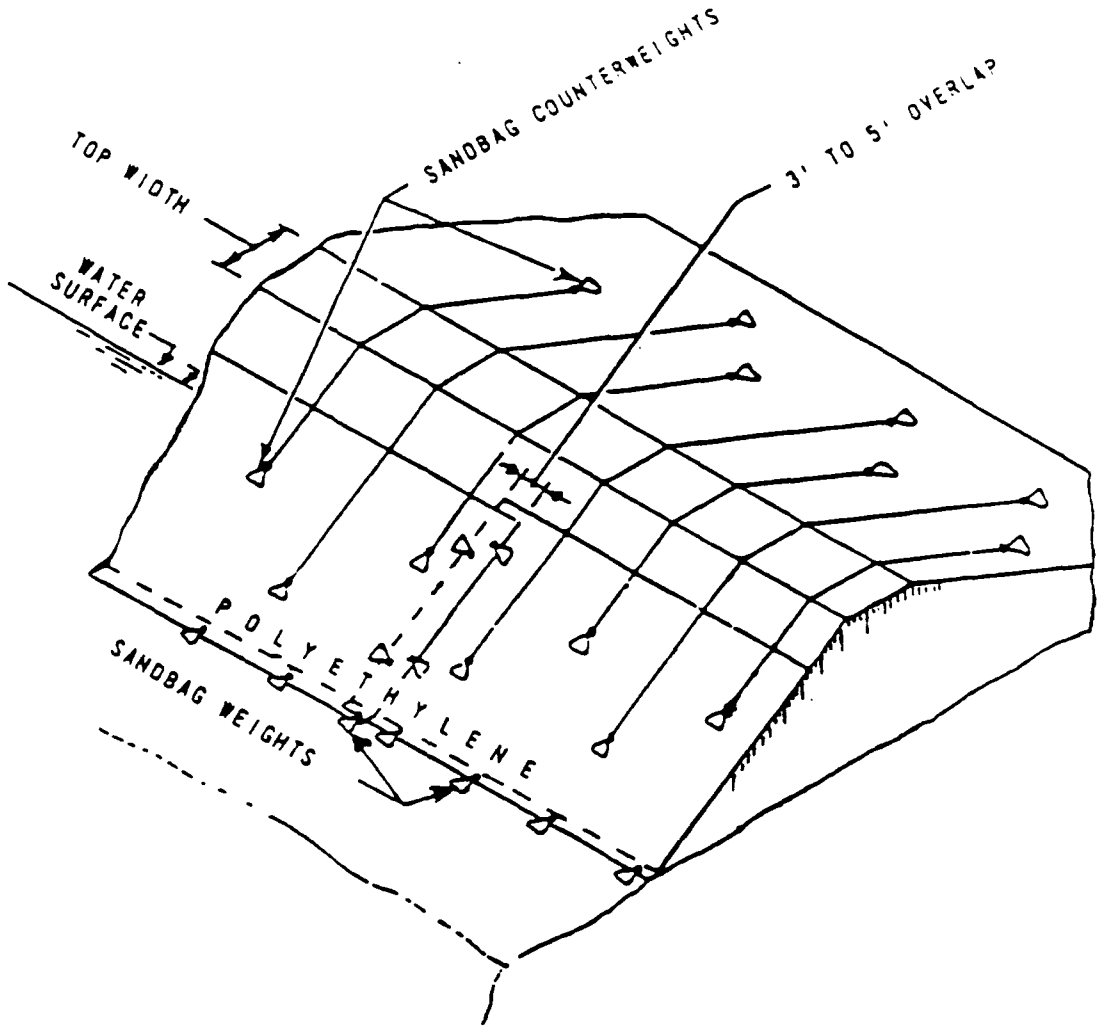
PLATE B-2



TIME REQUIRED TO CONSTRUCT SANDBAG RINGS OF VARIOUS SIZES

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

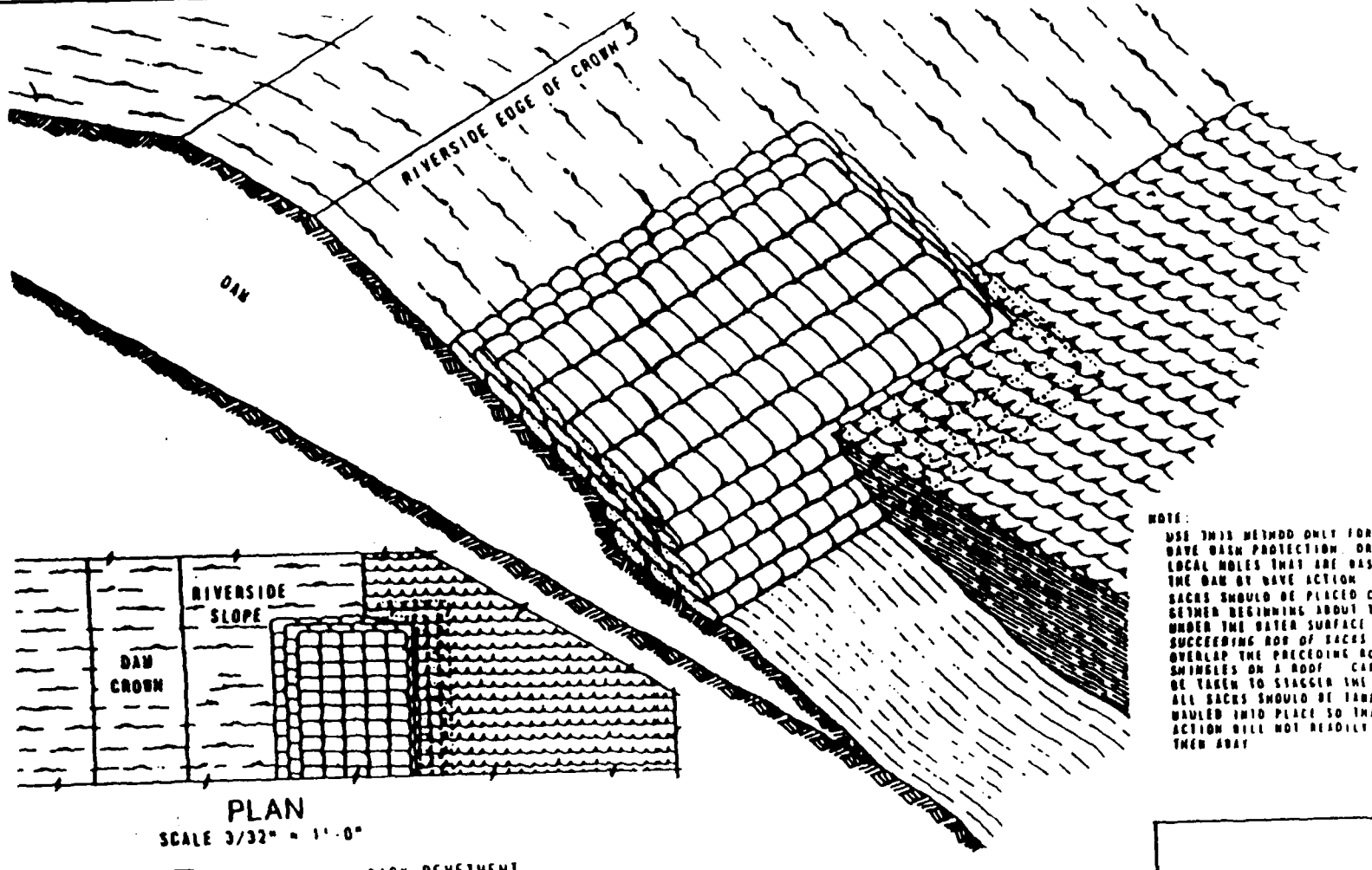
PLATE B-3



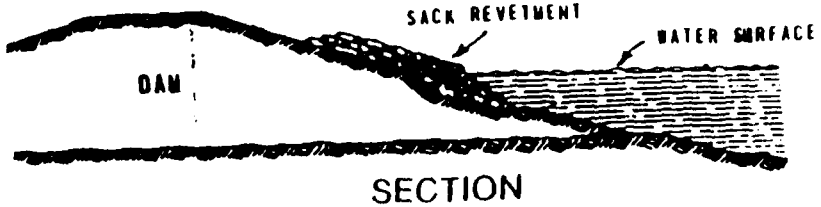
PLACEMENT OF POLYETHYLENE SHEETING IN THE WET

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE B-4



PLAN
SCALE 3/32" = 1'-0"



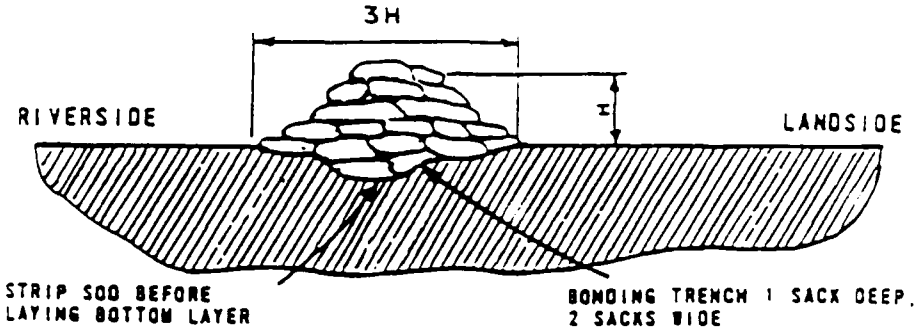
SECTION
SCALE 3/32" = 1'-0"

NOTE:
USE THIS METHOD ONLY FOR MINOR WAVE WASH PROTECTION OR TO FILL LOCAL HOLES THAT ARE WASHED IN THE DAM BY WAVE ACTION. THE SACKS SHOULD BE PLACED CLOSE TO GETHER BEGINNING ABOUT TWO FEET UNDER THE WATER SURFACE. EACH SUCCEEDING ROW OF SACKS SHOULD OVERLAP THE PRECEDING ROW LIKE SHINGLES ON A ROOF. CARE SHOULD BE TAKEN TO STAGGER THE JOINTS. ALL SACKS SHOULD BE TAMPED OR HAULED INTO PLACE SO THAT WAVE ACTION WILL NOT READILY WASH THEM AWAY.

SACK REVETMENT

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT

PLATE



SECTION

NOTE:

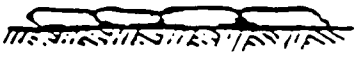
ALTERNATE DIRECTION OF SACKS WITH BOTTOM LAYER PARALLEL TO FLOW, NEXT LAYER PERPENDICULAR TO FLOW, ETC.

LAP UNFILLED PORTION UNDER NEXT SACK.

TYING OR SEWING SACKS NOT NECESSARY..

TAMP THOROUGHLY IN PLACE.

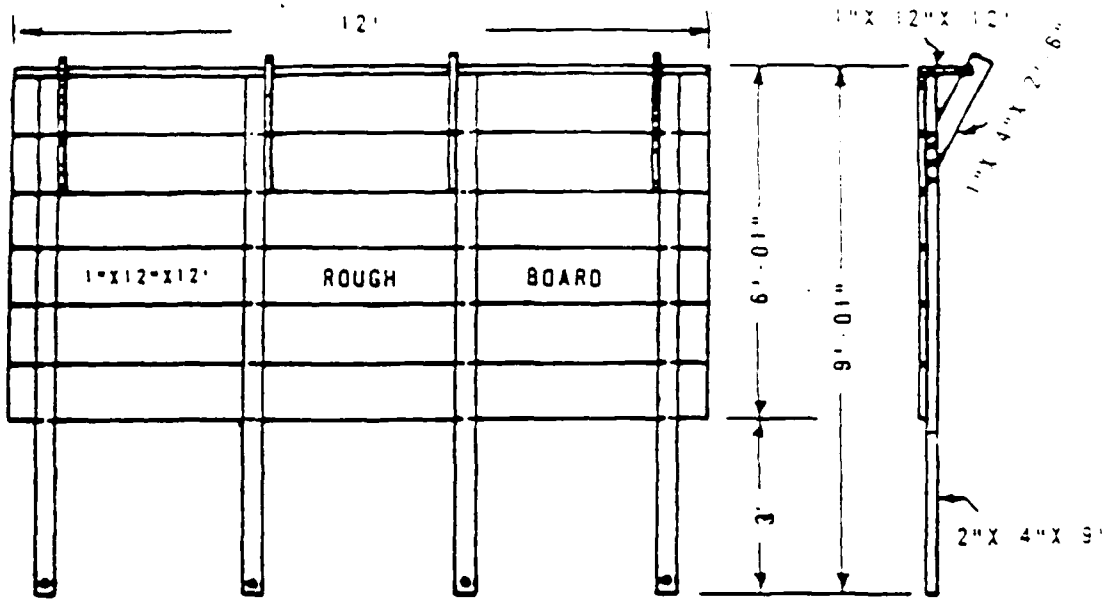
SACKS SHOULD BE APPROXIMATELY 1/2 FULL OF SAND.



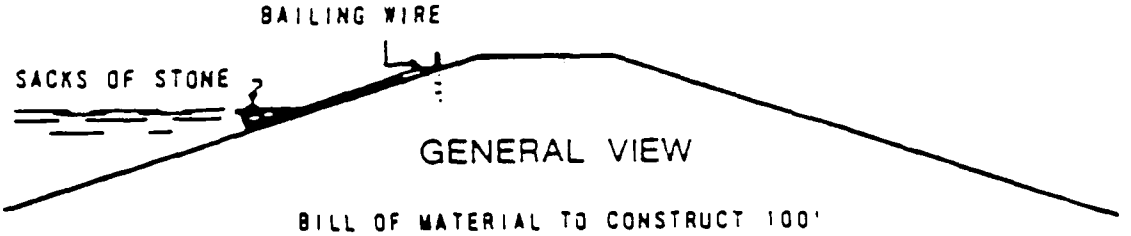
METHOD OF LAPPING SACKS

SANDBAG BARRIER

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS



PLAN ELEVATION



GENERAL VIEW

BILL OF MATERIAL TO CONSTRUCT 100'

56 PCS. 1"X 12"X 12'	32 PCS. 1"X 4"X 2'-6"
32 PCS. 2"X 4"X 9'	32 PCS. 2"X 4"X 2'

PERSONNEL REQUIRED FOR PLACING PLANKS -
4.2 - 5.8 WORKERS HOURS PER 100 SQUARE FEET.

TYPE OF MOVEABLE WAVE WASH PROTECTION

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE B-7

ENGINEERING PROPERTIES OF VARIOUS SOIL TYPES[1]

Typical Names of Soil Groups	Group Symbols	Important Properties			
		Permeability when Compacted	Shearing Strength when Compacted and Saturated	Compressibility when Compacted and Saturated	Workability as a Construction Material
Well-graded gravels, gravel-sand mixtures, little or no fines	GW	pervious	excellent	negligible	excellent
Poorly graded gravels, gravel-sand mixtures, little or no fines	GP	very pervious	good	negligible	good
Silty gravels, poorly graded gravel-sand-silt mixtures	GM	semipervious to impervious	good	negligible	good
Clayey gravels, poorly graded gravel-sand-clay mixtures	GC	impervious	good to fair	very low	good
Well-graded sands, gravelly sands, little or no fines	SW	pervious	excellent	negligible	excellent
Poorly graded sands, gravelly sands, little or no fines	SP	pervious	good	very low	fair
Silty sands, poorly graded sand-silt mixtures	SM	semipervious to impervious	good	low	fair
Clayey sands, poorly graded sand-clay mixtures	SC	impervious	good to fair	low	good
Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	ML	semipervious to impervious	fair	medium	fair
Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	CL	impervious	fair	medium	good to fair
Organic silts and organic silt-clays of low plasticity	OL	semipervious to impervious	poor	medium	fair
Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	MH	semipervious to impervious	fair to poor	high	poor
Inorganic clays of high plasticity, fat clays	CH	impervious	poor	high	poor
Organic clays of medium to high plasticity	OH	impervious	poor	high	poor
Peat and other highly organic soils	Pt	—	—	—	—

1. Reference (20) - Earth Manual, Bureau of Reclamation, Second Edition.

ENGINEERING PROPERTIES OF VARIOUS SOIL TYPES

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE B-8

USES OF VARIOUS SOIL TYPES[1]

Typical Names of Soil Groups	Group Symbols	Relative Desirability for Various Uses									
		Rolled Earth Dams			Canal Sections		Foundations		Roadways		
									Fills		
		Homogeneous Embankment	Core	Shell	Erosion Resistance	Compacted Earth Lining	Seepage Important	Seepage not Important	Frost Heave not Possible	Frost Heave Possible	Surfacing
Well-graded gravels, gravel-sand mixtures, little or no fines	GW	—	—	1	1	—	—	1	1	1	3
Poorly graded gravels, gravel-sand mixtures, little or no fines	GP	—	—	2	2	—	—	3	3	3	—
Silty gravels, poorly graded gravel-sand-silt mixtures	GM	2	4	—	4	4	1	4	4	9	5
Clayey gravels, poorly graded gravel-sand-clay mixtures	GC	1	1	—	3	1	2	6	5	5	1
Well-graded sands, gravelly sands, little or no fines	SW	—	—	3 if gravelly	6	—	—	2	2	2	4
Poorly graded sands, gravelly sands, little or no fines	SP	—	—	4 if gravelly	7 if gravelly	—	—	5	6	4	—
Silty sands, poorly graded sand-silt mixtures	SM	4	5	—	8 if gravelly	5 erosion critical	3	7	8	10	6
Clayey sands, poorly graded sand-clay mixtures	SC	3	2	—	5	2	4	8	7	6	2
Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	ML	6	6	—	—	6 erosion critical	6	9	10	11	—
Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	CL	5	3	—	9	3	5	10	9	7	7
Organic silts and organic silt-clays of low plasticity	OL	8	8	—	—	7 erosion critical	7	11	11	12	—
Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	MH	9	9	—	—	—	8	12	12	13	—
Inorganic clays of high plasticity, fat clays	CH	7	7	—	10	8 volume change critical	9	13	13	8	—
Organic clays of medium to high plasticity	OH	10	10	—	—	—	10	14	14	14	—
Peat and other highly organic soils	Pt	—	—	—	—	—	—	—	—	—	—

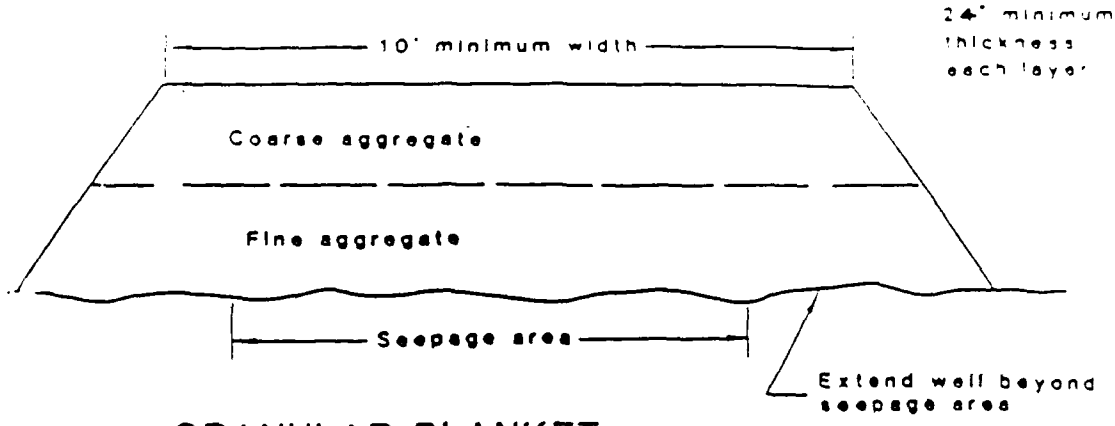
1. Reference (20) - Earth Manual, Bureau of Reclaimation, Second Edition.

2. For a landside berm a GW or GP soil would work best, if available. If such a soil is not readily available, and SP or SW soil could be used (if gravelly) for the lower layer of the blanket with a coarse gravel or rock blanket on top. Depending upon the site, adequate material may not be available. If materials for emergency repair of the dam are not readily available at the site, it may be desirable to haul the materials in advance and stockpile them in a safe location with proper protection. - Reference (22) - Emergency Plan for Pokegma Dam and Reservoir.

USES OF VARIOUS SOIL TYPES

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE B-9



GRANULAR BLANKET

APPROXIMATE CONSTRUCTION REQUIREMENTS

Blanket Area ($ft.^2$)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
Material Req'd Per Layer ($yd.^3$)	40	80	120	150	190	225	270	300	330	370
No. Trucks & Drivers	3	3	6	6	6	8	10	10	12	12
No. Graders & Operators	5	5	10	10	15	15	15	20	20	20
Total Time Req'd. (Hrs.)	4	8	6	8	8	8	8	8	9	10

GRANULAR BLANKET

EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE B-10

APPENDIX C
EMERGENCY NOTIFICATION SUBPLAN

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLES

APPENDIX C
EMERGENCY NOTIFICATION SUBPLAN

C-1. Introduction

Conditions affecting operation of Pine River Dam could result in a hazard to life and/or property because of high reservoir levels or sudden release of large volumes of water. Prompt issuance of appropriate notifications is essential for minimizing hazards to life and property.

a. Purpose

This subplan implements a portion of the Corps program to prepare emergency plans for all Corps dams. It establishes procedures for issuing notifications of impending and existing emergencies affecting the operation and safety of Pine River Dam and Reservoir.

b. Scope

This subplan specifies notifications and other actions to be taken upon declaration of a preemergency or emergency. Notifications and actions specified are those necessary for the following:

(1) Ensuring safety.

(2) Vacating project areas where emergency operations and repairs may be conducted.

(3) Internal coordination of Corps of Engineers activities.

(4) Coordination with non-Federal units of government and other Federal agencies.

c. Applicability

This subplan applies to all Corps elements and field offices concerned with operation of Pine River Dam.

C-2. Definitions

a. Preemergency

A preemergency condition is one in which some impending or existing threat to the safe operation of the dam or reservoir is identified but no significant hazard to life or property is expected. Declaration of a preemergency is internal to the Corps of Engineers and does not require notification of other parties or warnings to evacuate.

b. Emergency

An emergency condition is one in which the occurrence of a significant hazard to life and/or property is very probable or certain. Conditions

justifying declaration of an emergency may be imminent or longer term. Declaration of an emergency requires notification of key personnel and issuance of warnings to evacuate potentially hazardous areas.

c. Resource Manager

The term Resource Manager means the individual in charge at the Pine River Dam and Reservoir project site.

d. Mississippi Headwaters Project Office

The term Mississippi Headwaters Project Office means the person in charge of the Mississippi Headwaters Project Office.

e. District

The term District identifies one of the following elements depending on which is appropriate for the situation at hand.

(1) Dam Safety Officer. The Dam Safety Officer must be kept informed of all preemergency or emergency situations. Responsible for identifying and/or providing the necessary engineering or technical support required for the preemergency or emergency. Also responsible for keeping the Dam Safety Committee and the NCD Dam Safety Officer informed of the preemergency or emergency.

(2) Project Operations Branch. Responsible for identifying a person-in-charge of the preemergency or emergency situation. Responsible for keeping the Dam Safety Officer informed of the preemergency or emergency. Also responsible for matters involving normal dam operations and/or other matters not covered by the other District elements.

(3) Emergency Operations Center. Provides 24-hour telephone contact with the District Office. Responsible for keeping the Dam Safety Officer, the Commander/District Engineer, and NCD Emergency Operations Center in contact and up to date with the current operations and site staffing requirements. Also responsible for matters involving national security, disasters, and mobilization.

(4) Water Control Center. Part of Hydrology Section in Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving reservoir regulation. The Water Control Center collects and monitors hydrometeorological data and informs the Resource Manager of required discharge flows.

(5) Geotechnical Design Section. A section in the Geotechnical, Hydraulics and Hydrologic Engineering Branch. Responsible for matters involving the structural integrity of the dam.

(6) Design Branch. Responsible for matters involving the structural integrity of the outlet structures.

(7) Project Management Branch. Responsible for management support.

(8) Planning Division. Responsible for management support and matters involving environmental analysis and cultural resources.

C-3. Basis of Activation

This subplan is to be activated immediately upon declaration of a preemergency or emergency.

C-4. Parties to be Notified

a. Corps Offices

Corps offices to be notified of all declared preemergencies or emergencies are listed in table C-1.

b. Other Parties

Other parties to be notified according to the nature of an emergency or preemergency are listed in table C-2.

c. For High Pool Levels

Parties to be notified in the event of anticipated high pool levels are identified in table C-3.

C-5. Responsibility for Notification

Notifications listed in tables C-1 and C-2 are the responsibility of the office (Resource Manager, Mississippi Headwaters Project Office or District) declaring the preemergency or emergency. Assistance in making notifications may be requested from other Corps offices and/or other parties. If all communications between offices are disrupted after declaration of a preemergency or emergency, each office will assume responsibility for making all notifications.

C-6. Communications

a. Corps Offices

(1) Normal

Communications between the District and Resource Manager are normally by radio. Radios at the project administration office and District's Emergency Operations Center will be manned on a 24-hour basis during all flood emergencies and whenever a preemergency or emergency is in effect. (Office and home phone numbers of key Corps personnel are listed in table C-1.)

(2) Back-up

The telephone communications network among the District Office, Project Operations Office, and Mississippi Headwaters Project Office will be used to back up radio communications. Telephones at each office will be manned as dictated during all flood emergencies and whenever a preemergency or emergency is in effect and radio service is disrupted. Information on radio frequencies and call letters for key contacts is listed in table C-1.

(3) Emergency

When both radio and telephone communications between the District Office and project area are lost, others equipped with radio or telephone facilities will be called on for assistance. Those to whom application for assistance may be made are identified in tables C-1 and C-2 along with telephone information.

b. Other Parties

(1) Normal

Communications with other parties will normally be by telephone. Office and home phone numbers of key contacts are listed in table C-2.

(2) Back-up

Communications with other parties will be by radio if telephone service is disrupted. Table C-2 also lists parties who can be requested to forward notifications to offices lacking radio equipment.

C-7. Timing of Notifications

Parties listed in table C-1 are to be notified as soon as possible after declaration of a preemergency or emergency. Notifications listed in table C-2 depend on reservoir water elevation and other conditions shown in table C-3 and should be made as soon as a high probability of the eventual need for notification is predicted.

C-8. Content of Notification Message

a. Corps Offices

Notifications are to include the key information needed as a basis for decision-making and/or action including, as appropriate and to the extent possible, the following:

(1) Description of Situation

(a) Nature and severity of problem(s).

(b) Current and predicted reservoir conditions including water elevation, inflow, and discharge.

(c) Current and forecasted weather conditions.

(2) Action Planned or Underway

(a) Type of corrective actions.

(b) Estimated time to complete corrective actions.

(c) Outlook for success.

(d) Assistance required/being furnished.

(e) Potential complications.

(f) Recommended evacuation.

(3) Other

(a) Staff at Pine River Dam site.

(b) Visitors at project.

(c) Road conditions.

b. Other Parties

Notification messages are to include a description of the nature of impending or existing hazard, potential timing of its occurrence, and recommendations for evacuation and other action (needed evacuation on project lands managed by the Corps will be directed rather than recommended).

C-9. Preemergency Actions

a. Resource Manager

For a Resource Manager declared preemergency or suspected preemergency, the Resource Manager must notify the Mississippi Headwaters Project Office.

If the Mississippi Headwaters Project Office cannot be reached, contact the Dam Safety Officer, Project Operations Branch, and Emergency Operations Center.

b. Area Project Office

Evaluate the situation and declare a preemergency or emergency if warranted.

Notify Dam Safety Officer, Project Operations Branch, and Emergency Operations Center.

Provide assistance as needed to Resource Manager and District Office.

c. District

(1) Dam Safety Officer

(a) The Dam Safety Officer is to be kept informed of all conditions of the preemergency.

(b) Responsible for identifying and/or providing the necessary engineering or technical support required to resolve the preemergency situation.

(c) Evaluate the situation and declare a preemergency if warranted.

(d) Notify the North Central Division Dam Safety Officer if the preemergency was declared by the Resource Manager, the Mississippi Headwater Project Office, or District Office.

(e) Notify the Dam Safety Committee, the Emergency Operations Center, and the Project Operations Branch of the situation.

(2) Project Operations Branch

(a) Must be kept informed of all preemergency situations.

(b) Responsible for identifying a person-in-charge of the preemergency. Also, responsible for matters involving normal dam operations and/or any other matters not covered by other District elements.

(c) Responsible for contacting the Dam Safety Officer for engineering and technical assistance and keeping him informed of the situation. Also, contact the Emergency Operations Center and keep it informed of the situation.

(d) Evaluate the situation and declare a preemergency if warranted.

(e) Provide needed assistance and/or instructions to the Resource Manager and person-in-charge of the preemergency.

(3) Emergency Operations Center

(a) Must be kept informed of all preemergency situations.

(b) Provide 24-hour telephone service.

(c) Responsible for contacting Dam Safety Officer, Project Operations Branch, District Engineer, Public Affairs Officer, and the NCD Emergency Manager or Emergency Operations Center.

(d) Responsible for matters involving National Security, Disasters, and Mobilization. Provide emergency response in accordance with ER 500-1-1, National Disaster Procedures.

(e) Evaluate the situation and declare a preemergency if warranted.

(4) Others. District Office personnel listed under this category are only to be contacted if none of the above District elements can be reached.

(a) Evaluate the preemergency conditions and declare a preemergency if warranted.

(b) Notify the Dam Safety Officers, the Emergency Operations Center, and the Project Operations Branch as soon as possible.

(c) If the Project Operations Branch cannot be contacted, appoint a temporary person-in-charge of the preemergency.

(d) Provide needed assistance and/or instructions to the Resource Manager and person-in-charge of the preemergency.

C-10. Emergency Actions

The order in which the following emergency actions are to be performed would depend on the type and timing of occurrence of the emergency. Priority should always be given to the immediate safety of human life. For example, in the case of a failure at normal pool and low tail water, because this situation quickly results in a great hazard to life, the Resource Manager would first want to take action to notify and evacuate areas in the vicinity of the dam. The Resource Manager then would proceed with the other emergency actions and notifications.

a. Resource Manager

(1) For a Resource Manager declared emergency or suspected emergency, the Resource Manager must notify the Mississippi Headwaters Project Office. If the Mississippi Headwaters Project Office cannot be reached, contact the Project Operations Branch or next higher authority and Emergency Operations Center.

(2) Cancel normal work schedule and provide for 24-hour duty as needed.

(3) Assess project areas that are or may become unsafe, including, but not limited to the following:

(a) Reservoir water surface.

(b) Day-use and recreational areas within project boundaries including those managed by others.

(4) Identify areas required for conduct of emergency operations and repairs including any necessary access routes.

(5) Take action to notify and evacuate areas that are unsafe or potentially unsafe or where emergency operations and repair work may be carried out including, as appropriate:

(a) Directing evacuation of affected project areas managed by the Corps.

(b) Closing project roads to incoming traffic.

(c) Moving equipment to safe areas.

(6) Request assistance as needed in carrying out items (5)(a) and (5)(b) above from agencies listed in table C-2.

(7) Assume District responsibilities for notifications if the Resource Manager declared the emergency.

(8) Verify appropriate warnings if announced over local radio and television.

b. Mississippi Headwaters Project Office

Evaluate the situation and declare an emergency condition if warranted.

Notify Dam Safety Officer, Project Operations Branch and Emergency Operations Center.

Provide assistance to Resource Manager or District as required to accomplish the following tasks:

(1) Cancel normal work schedule and provide for key staff as needed.

(2) Assess project areas that are or may become unsafe including, but not limited to the following:

(a) Reservoir water surface.

(b) Day-use and recreational areas within the project boundaries including those managed by others.

(3) Identify areas required for conduct of emergency operations and repairs including any necessary access routes.

(4) Take action to notify and evacuate areas that are unsafe or potentially unsafe or where emergency operations and repair work may be carried out including, as appropriate:

(a) Directing evacuation of affected project areas managed by the Corps.

(b) Closing project roads to incoming traffic.

(c) Moving equipment to safe areas.

(5) Request assistance as needed in carrying out items (4)(a) and (4)(b) above from the agencies listed in tables C-1 and C-2.

(6) Assume District responsibilities for notifications if the Resource Manager declared the emergency condition.

(7) Verify that appropriate warnings are announced over the local radio and television.

c. District

(1) Dam Safety Officer

(a) The Dam Safety Officer is to be kept informed of all conditions of the emergency situation.

(b) Responsible for identifying and/or providing the necessary engineering or technical support required to resolve the emergency situation.

(c) Evaluate the situation and declare an emergency if warranted.

(d) Inform the North Central Division Dam Safety Officer who in St. Paul District declared the emergency. The declaration could have been made by the Resource Manager, Mississippi Headwaters Area Project Office, or the District Office.

(e) Notify the Dam Safety Committee, the Emergency Operations Center, the Project Operations Branch, and the NCD Emergency Operations Center if the St. Paul District Emergency Operations Center has not done so.

(2) Project Operations Branch

(a) Must be kept informed of all emergency situations.

(b) Responsible for identifying a person-in-charge of the emergency. Also, responsible for matters involving normal Dam Operations and/or any other matters not covered by other District elements.

(c) Responsible for contacting the Dam Safety Officer for engineering and technical assistance and keeping him informed of the situation. Also, contact the Emergency Operations Center and keep it informed of the situation.

(d) Evaluate the situation and declare an emergency if

warranted.

(e) Provide needed assistance and/or instructions to the Resource Manager, Mississippi Headwaters Project Office, and person-in-charge of the emergency.

(f) Cancel normal work schedule and provide for key staff as needed.

(g) Determine which of the planning conditions represents potential inundation and need for evacuation: (1) flood without failure, (2) flood with failure, and (3) normal pool low tail water dam failure.

(h) Determine need for warning of high reservoir levels.

(i) Formulate and issue warning message(s) to affected non-Federal parties.

(j) Verify appropriate warnings as released over local radio and television.

(3) Emergency Operations Center

(a) Must be kept informed of all emergency situations.

(b) Provide 24-hour telephone service.

(c) Responsible for contacting Dam Safety Officer, Project Operations Branch, District Engineer, Public Affairs Officer, and the NCD Emergency Manager or Emergency Operations Center.

(d) Responsible for matters involving National Security, Disasters, and Mobilization. Provide emergency response in accordance with ER 500-1-1, National Disaster Procedures.

(e) Evaluate the situation and declare an emergency if warranted.

(4) Others

(a) The District personnel listed under this category are only to be contacted if none of the above District personnel can be reached.

(b) Evaluate the emergency conditions and declare an emergency if warranted. Notify the Dam Safety Officer, the Emergency Center, and the Project Operations Branch as soon as possible.

(c) If the Project Operations Branch cannot be reached, appoint a temporary person-in-charge of the emergency.

(d) Provide needed assistance and/or instructions to the Resource Manager and person-in-charge of the emergency.

d. North Central Division

Notify the Office of the Chief of Engineers and other Federal agencies as appropriate.

e. Office of the Chief of Engineers

Notify other Federal agencies as appropriate, such as the Federal Emergency Management Agency.

C-11. Example Messages

Preparation of warning messages should begin as soon as their potential need is apparent so that they can be issued promptly when an emergency is declared. When time is available, all public notices should be released by the Public Affairs Office. Contact Emergency Management or the Hastings Electronic Service Center if the Public Affairs Office cannot be reached. In some cases, an emergency may be declared with little or no advance notice. The following example messages provide a model for the first announcements in such cases. The Public Affairs Office would then be contacted as soon as time permits. It would release subsequent announcements to provide additional details.

a. Announcement for Slowly Developing Conditions

THE ARMY CORPS OF ENGINEERS AT ST. PAUL ANNOUNCED AT (time) TODAY THAT AN EMERGENCY CONDITION EXISTS AT (name of dam) DAM AS RESULT OF (general description of problem). THE DAM IS ON (stream) ABOUT (distance) MILES UPSTREAM OF (name of downstream community and State).

A CORPS SPOKESPERSON SAID THAT THE WATER LEVEL OF (name of reservoir) WAS BEING LOWERED (as a precautionary measure/to reduce pressure on the dam/to enable repair work).

THE SPOKESPERSON EMPHASIZED THAT THE DRAWDOWN OF THE POOL WAS BEING CARRIED OUT UNDER CONTROLLED CONDITIONS AND THERE IS NO IMMEDIATE DANGER OF THE DAM FAILING. HOWEVER, THE LARGE RELEASES OF WATER THAT ARE BEING MADE MAY CAUSE FLOODING ALONG (stream). RESIDENTS OF LOW LYING AREAS ALONG (STREAM) SHOULD (evacuate/be alert for high water and prepare to evacuate).

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

b. Announcement for Rapidly Developing Conditions

URGENT: THE ARMY CORPS OF ENGINEERS HAS ANNOUNCED THAT (name of dam) DAM IS IN IMMINENT DANGER OF FAILURE. THE DAM IS ABOUT (distance) MILES UPSTREAM OF (name of downstream community and State).

ATTEMPTS TO SAVE THE DAM ARE UNDERWAY BUT THEIR SUCCESS CANNOT BE DETERMINED YET. RESIDENTS ALONG THE (stream) SHOULD EVACUATE TO HIGH GROUND IMMEDIATELY. RESIDENTS ALONG THE (stream) IN THE VICINITY OF (city) AND DOWNSTREAM SHOULD REMAIN ALERT FOR FURTHER INFORMATION.

IF THE DAM FAILS, WATER WILL TAKE APPROXIMATELY (time) HOURS TO REACH THE LOWER END OF (city, stream, etc.). AREAS CLOSER TO THE DAM WILL BE FLOODED SOONER.

ADDITIONAL INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

c. Announcement for High Reservoir Levels

THE ARMY CORPS OF ENGINEERS AT ST. PAUL ANNOUNCED AT (time) TODAY AN EMERGENCY CONDITION EXISTS AROUND (name of reservoir) AS A RESULT EXPECTED HIGH WATER LEVELS. THE LAKE IS ON (stream) ABOUT (distance) MILES UPSTREAM OF (community and State).

THE CORPS SPOKESPERSON SAID THAT THE WATER LEVEL IN THE LAKE WAS EXPECTED TO REACH ELEVATION (elev) AT (time) AS A RESULT OF (general description of problem). THIS WATER LEVEL WILL (describe major effects).

LARGE RELEASES OF WATER ARE BEING MADE FROM THE DAM IN AN ATTEMPT TO CONTROL THE LAKE LEVEL. RESIDENTS OF LOW LYING AREAS ALONG (stream) SHOULD BE ALERT TO POSSIBLE FLOODING AND PREPARE TO EVACUATE.

FURTHER INFORMATION WILL BE RELEASED AS PROMPTLY AS POSSIBLE.

TABLE C-1
NOTIFICATION LIST
FOR CORPS OF ENGINEERS
OFFICES (INTERNAL)

OBSERVER

1. Observe potential dam problem.
2. Gather pertinent facts to describe situation.
3. Assess whether slowly developing, rapidly developing or imminent failure.
4. Notify first available Dam Supervisor in order shown.

(If contact cannot be made with Dam Supervisors listed below, contact Area Project Office, Dam Safety Officer, Project Operations Branch, or Emergency Operations Center as shown on the attached list.)

DAM SUPERVISOR

	Office	Home Phone	Radio
Walter Hermerding	(218)692-4488	(218)692-2118	SSB/FM WUD640
Ray Nelson	(218)692-4488	(218)546-6219	

1. Assess observer's report.
2. Take necessary emergency actions.
3. Notify Area Project Office (Western Flood Control Office), Dam Safety Officer, Project Operations Branch, or Emergency Operations Center.

AREA PROJECT OFFICE

	Office	Home Phone	Radio
James Ruyak	(218)566-2306	(218)566-1294	SSB/FM WUD639

1. Assess the situtation.
2. Take necessary emergency actions.
3. Notify Dam Safety Officer, Project Operations Branch, or Emergency Operations Center.

2 of 4 3 of 4 4 of 4
(REFER TO SHEETS)

TABLE C-1
NOTIFICATION LIST
FOR CORPS OF ENGINEERS
OFFICES (INTERNAL)

PROJECT OPERATIONS BRANCH

	Office	Home Phone
Dennis Cin	(612)220-0320	(612)455-6786
Thomas Oksness	(612)220-0325	(612)439-0272
Dennis Erickson	(612)220-0322	(612)452-6850

Responsible for identifying a person-in-charge of the pre-emergency or emergency situation. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving normal dam operations, and/or matters not covered by other District elements. Project Operations Branch will contact Dam Safety Officer for engineering and technical assistance and keep him informed of situation.

OTHER DISTRICT PERSONNEL

Office	Office	Home Phone	Radio	
Western Flood Control Office				
Timothy Bertschi	(701)232-1894	(701)232-5967	FM	WUD 642
Headwaters Project Office				
James Ruyak	(218)566-2306	(218)566-1294	FM	WUD 639
Mississippi River Project Office				
Richard Otto	(507)895-6341	(507)895-6224	FM	WUD 645
Resource Managers				
Eau Galle/ Mathiesen	(715)778-5562	(715)778-4597	FM/SSB	WUD 643
Homme/ Odegaard	(701)845-2970	(701)845-2982	FM/SSB	WUD 636
Baldhill/ Odegaard	(701)845-2970	(701)845-2982	FM/SSB	WUD 636
Lk.Traverse/ Salberg	(612)563-4586	(612)563-4586	FM/SSB	WUD 638
Orwell/ Schimming*	(218)736-6463	(218)736-6510	FM/SSB	WUD 637
Lac Qui Parle/ Hanson	(612)269-6303	(612)269-9632	FM/SSB	WUD 630
Sandy/ Daly	(218)426-3482	(218)426-3482	FM/SSB	WUD 632
Pokegama/ Kleinert	(218)326-6128	(218)327-2573	FM/SSB	WUD 633
Leech Lake/ Zahalka	(218)654-3145	(218)566-1642	FM/SSB	WUD 634
Pine River/ Hermerding	(218)692-4488	(218)692-2118	FM/SSB	WUD 640
Winnibigoshish/ Dickson*	(218)246-8107	(218)566-2952	FM/SSB	WUD 631
Gull Lake/ Espenson	(218)829-3334	(218)778-4255	FM/SSB	WUD 635

*Maintenance Worker - Lake Traverse project retains managerial role at Orwell Dam, and Pokegama Dam for Winnibigoshish Dam.

TABLE C-1
NOTIFICATION LIST
FOR CORPS OF ENGINEERS
OFFICES (INTERNAL)

DAM SAFETY OFFICER*

	Office	Home Phone
Robert Post*	(612)220-0303	(612)437-1316
Wiliam Goetz	(612)220-0310	(612)454-3722
Stan Kumpula	(612)220-0304	(612)484-8957

To be informed of all pre-emergency or emergency situations. responsible for identifying and/or providing the necessary engineering or technical support required to resolve the pre-emergency or emergency situation.

DAM SAFETY COMMITTEE

	Office	Home Phone
Robert Post*	(612)220-0303	(612)437-1316
Wiliam Goetz	(612)220-0310	(612)454-3722
Helmer Johnson	(612)220-0602	(612)633-7791
Patrick Foley	(612)220-0610	(612)483-9575
Charles Spitzack	(612)220-0510	(612)645-7301
Dennis Cin	(612)220-0320	(612)455-6786
Dale Mazar	(612)220-0444	(612)631-1940
Stan Kumpula	(612)220-0304	(612)484-8957

NCD DAM SAFETY OFFICER*

	Office	Home Phone
Dam Safty Officer*	(312)353-6311	
Robert Neal	(312)353-6372	(708)541-1527
Don Leonard	(312)353-6355	**(708)359-3372**
Larry Hiipakka	(312)353-6358	**(708)355-3437**

OCE DAM SAFETY OFFICER*

	Office	Home Phone
John McPherson*	**(202)504-4538**	(703)659-2650
William McCormick	(202)272-0397	(703)569-4323
Edward Pritchett	(202)272-0207	(301)865-5876
Donald Dressler	(202)272-0220	(703)938-4727
Earl Eiker	(202)272-8500	(301)465-2120
John Elmore	(202)272-0196	(703)339-8279

TABLE C-1
NOTIFICATION LIST FOR CORPS OF ENGINEERS OFFICES (INTERNAL)

EMERGENCY OPERATIONS CENTER

	Office	Home Phone
District EOC	(612)220-0208	(24-hr. Number)
David Christenson	(612)220-0204	(612)690-5749

Twenty-four (24) hour telephone service. Must be kept informed of all pre-emergency or emergency situations. Also contact for matters involving national security, disasters, mobilization or NWR flood forecasts. Center will contact Dam Safety Officer, the Commander/District Engineer and NCD.

DISTRICT ENGINEER

	Office	Home Phone
Col. Roger L. Baldwin	(612)220-0300	(612)894-6410

PUBLIC AFFAIRS OFFICE

	Office	Home Phone
Kennon Gardner	(612)220-0201	(612)884-9023
24-Hr. Answer Machine	(612)220-0200	

NCD EMERGENCY MANAGER

	Office	Home Phone
Natural Disaster Planner Bernard Bochantin	(312)353-5275	(815)568-7544
Chief Emergency Management Tim Monteen	(312)886-8451	(708)961-2195

DISTRICT RADIO

Contact Electronic Service Center at	(612)437-2210	WUD6
SSB Primary		5400Khz
1st Alternate		6020Khz
Emergency		5015KhzLSB

For additional information see Appendix CNCS 500-1-1.

Table C-2 - Key contacts for emergency notifications (external)

Cities and Towns		Telephone Office	Residence
Cross Lake, MN	Police Dept.	(218)692-2222 (24 hours)	
Brainerd, MN	Police Dept.	(218)829-2805 (24 hours)	
	MN State Patrol	(218)828-2400	
COUNTIES			
Emergency		911	
Crow Wing County			
Sheriff		(218)829-4749 (24 hours)	
Emergency Management		(218)829-1711	(218)829-6293
STATE AGENCIES			
Emergency		911	
Statewide Emergency Number		1-800-422-0798	
MN Division of Emergency Management		(612)296-2233	(507)334-6507
Metro Area (Night & Non-Business Hrs.)		(612)649-5451	
Backup ONLY		(612)296-2100	
Region II Coordinator		(218)327-4496	(218)245-3711
MN Dept. of Natural Resources		(612)296-4800	(612)459-0785
MN State Patrol (Brainerd Area)		(218)828-2400	
MN State Patrol Metro		(612)297-3934	
FEDERAL AGENCIES			
National Weather Service		(612)725-3401	
Fish and Wildlife Service		(507)452-4232	

Table C-3 - Identifiation of emergency conditions and required internal and external notifications

Elevation*	Problem	Parties to be Notified	Action
1. HIGH RESERVOIR LEVEL			
1229.32	Normal pool	Mississippi Headwaters Project Office (MHPO) District	
1229.57	Top summer band		
1231.32	Full pool Maximum operating limit	MHPO District North Central Division (NCD) National Weather Service (NWS)	Apprise them of situation (for info. only).
2. EMERGENCY DRAWDOWN			
	Possible failure of Pine River Dam (Failure not imminent)	MHPO District NCD NWS Minnesota Division of Emergency Services (MN-DES) County Civil Defense Coordinators (CCDC) Brainerd, MN Police Cross Lake, MN Police Crow Wing County Sheriff	Apprise them of the situation and that we are increasing discharges.
3. IMMINENT DAM FAILURE			
1237.3	Overtopping of embankment (Failure of over-topping will not come without prior warning in the form of heavy runoff, large inflow and rapidly rising pool levels)	MHPO District NCD MN-DES CCDS'S NWS Brainerd, MN Police Cross Lake, MN Police Crow Wing County Sheriff Minnesota Highway Patrol	Apprise them of the situation. Use caution/ evacuate. (As appropriate.
	Failure of the embankment	MHPO District	Apprise them of the situation.

*Elevation refers to MSL 1929 adj.

APPENDIX D
INUNDATION MAP PACKAGE

TABLE OF CONTENTS

PLATES

APPENDIX D
INUNDATION MAPS

D-1. Introduction

This appendix presents the inundation maps and other hydraulic data for the area downstream of the Pine River Dam for the cases of PMF (probable maximum flood) without dam failure, PMF with dam failure, and failure at normal high pool level with low tail water.

D-2. Explanation of Maps

The attached maps indicate the area that could be flooded under the hypothesized conditions of (a) occurrence of a PMF at Pine River Dam and (b) occurrence of a failure of the dam concurrent with a PMF. The peak flows past Pine River Dam for these conditions are approximately 18,300 cfs (cubic feet per second) and 22,500 cfs, respectively. The possibility is extremely remote that either of these conditions will occur.

Preparation of the maps does not reflect on the safety or integrity of Pine River Dam. The maps have been prepared as part of a national program to prepare similar maps for all Federal dams.

The attached maps provide a basis for evaluating existing evacuation plans for the affected area and developing any further plans that are needed. The Corps of Engineers recommends that such evaluations be made and any needed supplemental plans be developed. Information on evacuation planning and examples of evacuation plans are available from the Corps of Engineers.

D-3. Use of Maps

The general procedure for use of the attached maps is as follows:

a. Determine the portion of your area of concern that would be affected by inundation or isolation.

b. Identify routes that would be used for movement of people from each part of the area to be evacuated.

c. Use the information to assess whether existing evacuation plans cover all the affected area and will provide for timely evacuation.

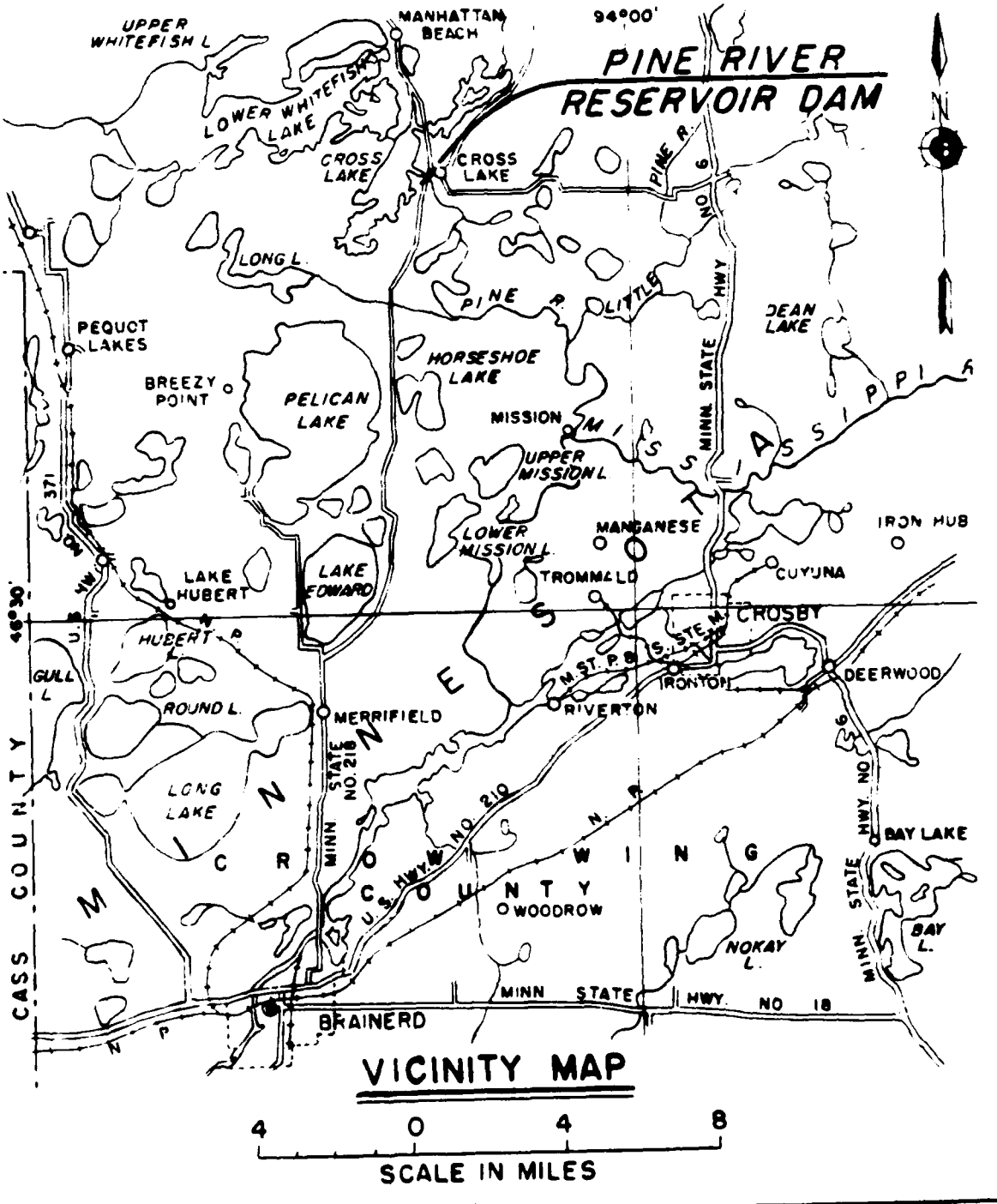
d. Identify the amount of time available for evacuation.

D-4. Definition of Terms

River mile	**The distance along the channel of the Pine River from the Pine River Dam.**
Peak elevation	**The computed maximum water surface elevation that would be reached at a location as a result of assumed conditions.**

Peak flood time	Elapsed time* after assumed event until peak elevation occurs.
NGVD	National Geodetic Vertical Datum (distance above mean sea level, 1929 adj.)
PMF (probable maximum flood)	The theoretical maximum flow that can be expected from the watershed.
Dam failure	Any condition resulting in the uncontrolled release of water other than over or through an uncontrolled spillway or outlet works.
Cross section	Point at which the shape of a stream channel or valley is measured, usually in a direction perpendicular to the direction of flow.
Emergency	A condition in which the occurrence of a significant hazard to life or property is possible or certain.

*Elapsed time for the case of PMF without failure is measured from the time at which the reservoir level exceeds the maximum operating limit (elevation 1231.32 feet). Elapsed time for the case of PMF with failure and failure at normal high pool level are measured from the beginning of failure.

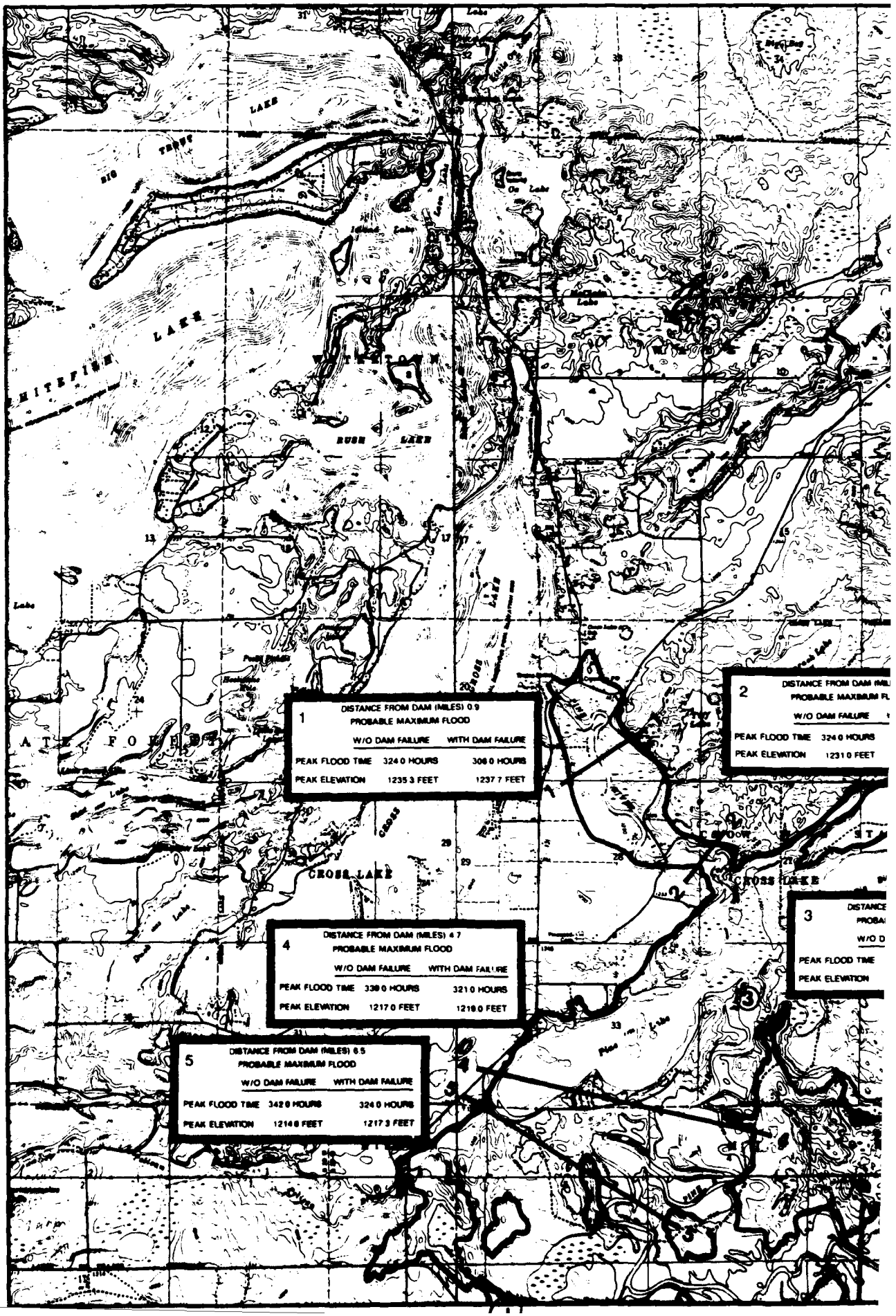


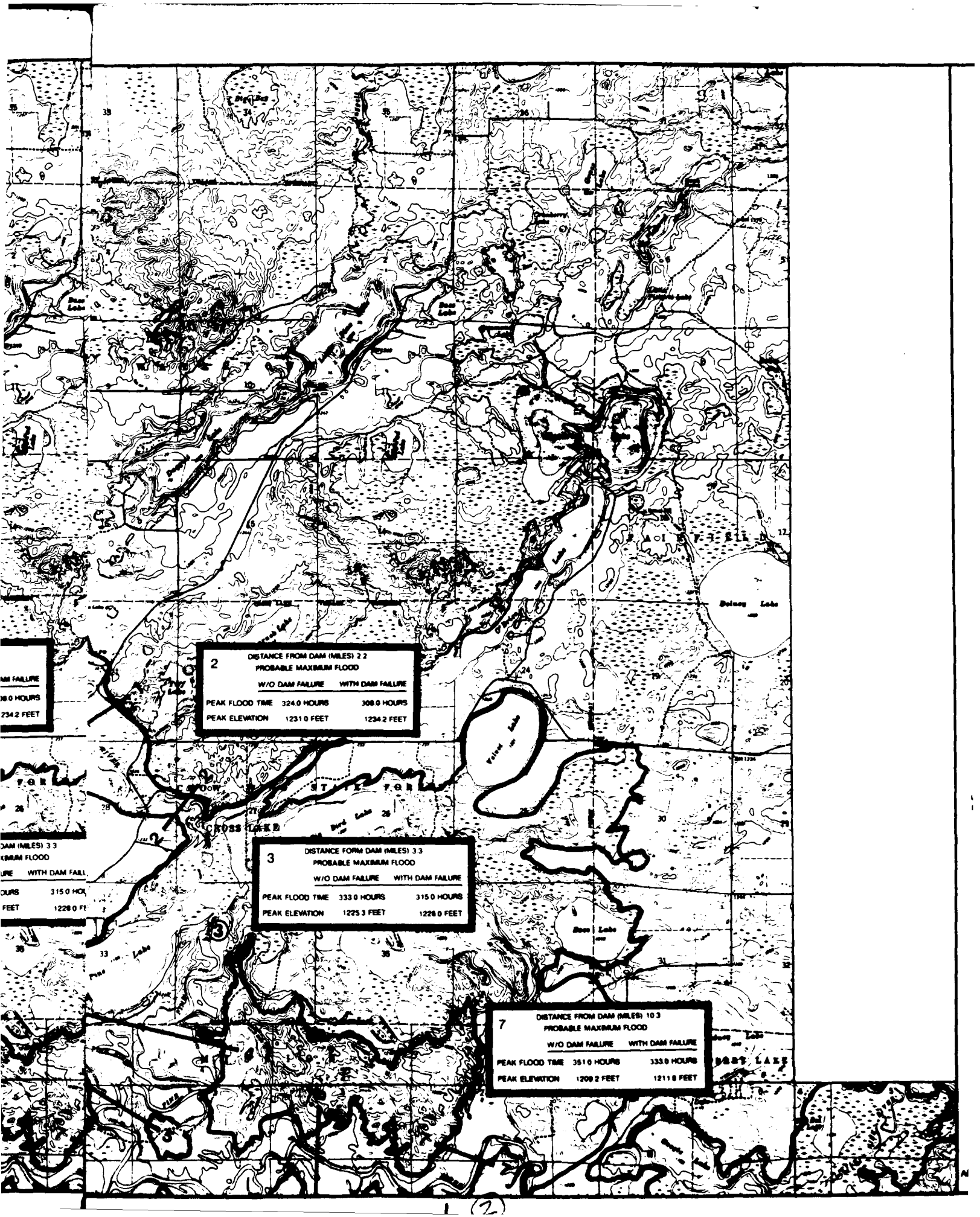
VICINITY MAP

DOWNSTREAM AREA MAP

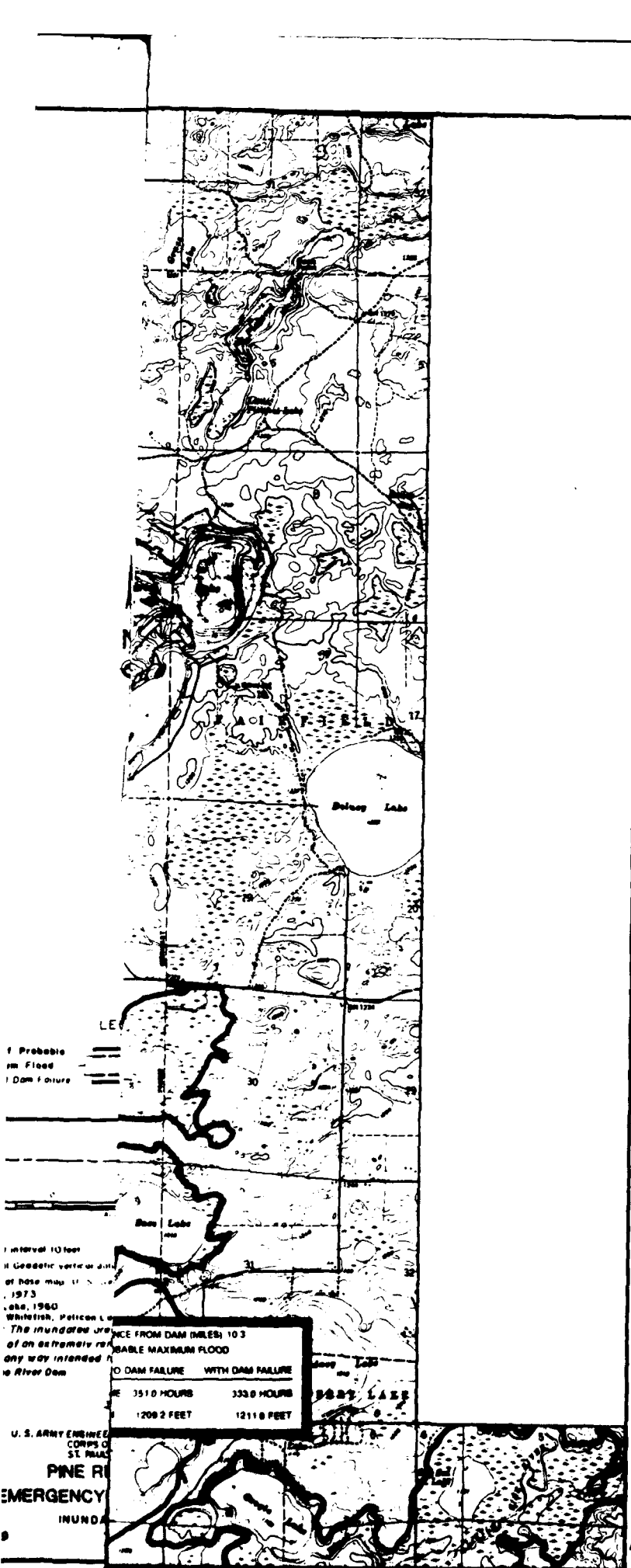
EMERGENCY ACTION PLAN
PINE RIVER DAM
AND
RESERVOIR
ST. PAUL DISTRICT
U.S. ARMY CORPS OF ENGINEERS

PLATE D-1


1
DISTANCE FROM DAM (MILES) 0.9
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 324.0 HOURS 306.0 HOURS
PEAK ELEVATION 1235.3 FEET 1237.7 FEET
2
PEAK FLOOD TIME 324.0 HOURS
PEAK ELEVATION 1231.0 FEET
3
4
DISTANCE FROM DAM (MILES) 4.7
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 339.0 HOURS 321.0 HOURS
PEAK ELEVATION 1217.0 FEET 1218.0 FEET
5
DISTANCE FROM DAM (MILES) 6.5
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 342.0 HOURS 324.0 HOURS
PEAK ELEVATION 1214.8 FEET 1217.3 FEET
CROSS LAKE
RUSH LAKE
LAKE


2
DISTANCE FROM DAM (MILES) 2.2
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE
WITH DAM FAILURE
PEAK FLOOD TIME 324.0 HOURS 308.0 HOURS
PEAK ELEVATION 1231.0 FEET 1234.2 FEET
3
DISTANCE FORM DAM (MILES) 3.3
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE
WITH DAM FAILURE
PEAK FLOOD TIME 333.0 HOURS 315.0 HOURS
PEAK ELEVATION 1225.3 FEET 1228.0 FEET
7
DISTANCE FROM DAM (MILES) 10.3
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE
WITH DAM FAILURE
PEAK FLOOD TIME 351.0 HOURS 333.0 HOURS
PEAK ELEVATION 1209.2 FEET 1211.8 FEET
CROSS LAKE
WEST LAKE

(2)



DISTANCE FROM DAM (MILES) 103		
PROBABLE MAXIMUM FLOOD		
	TO DAM FAILURE	WITH DAM FAILURE
TIME	351.0 HOURS	333.0 HOURS
STAGE	1209.2 FEET	1211.8 FEET

U. S. ARMY ENGINEER DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

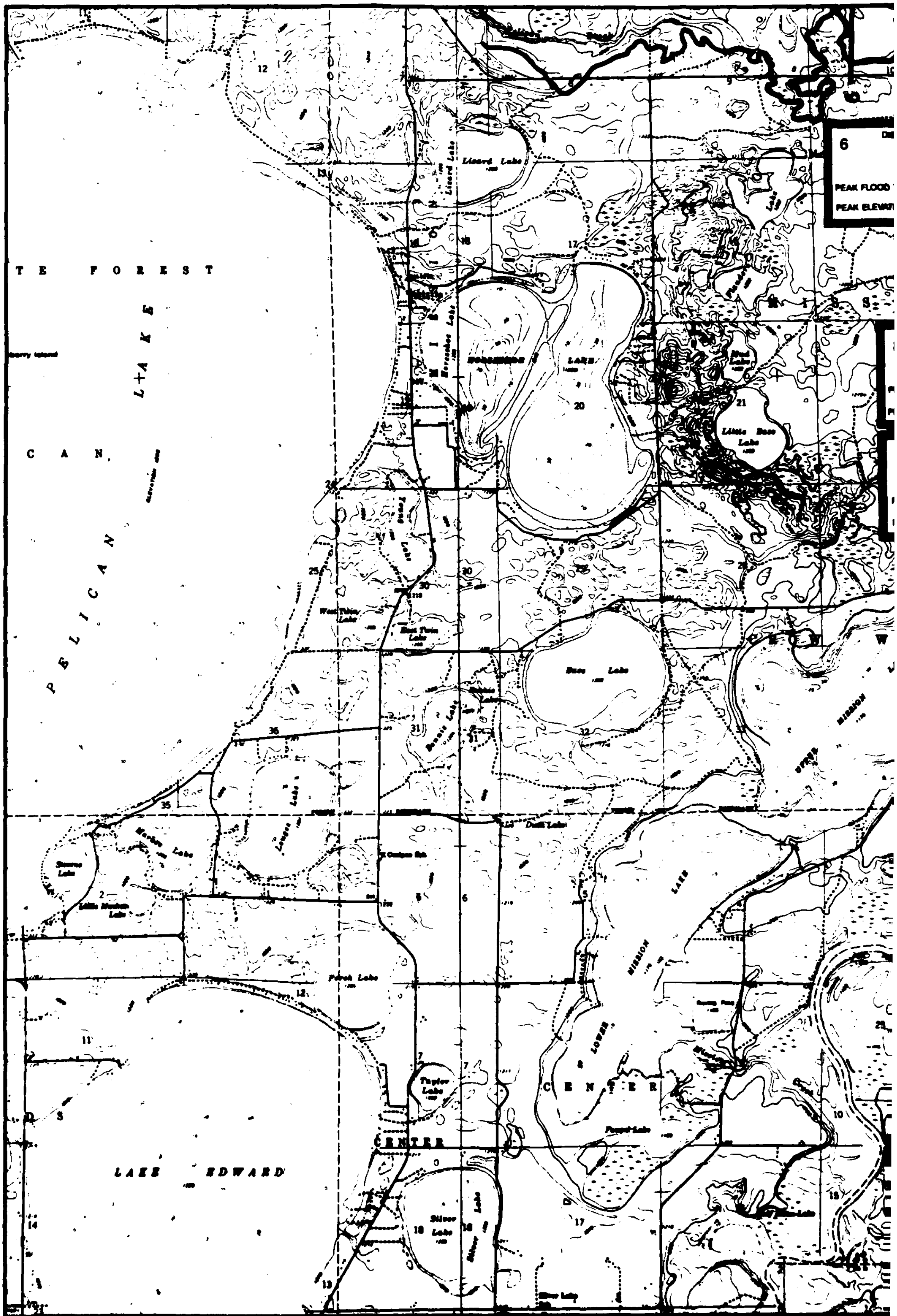
PINE RIVER DAM
EMERGENCY ACTION PLAN

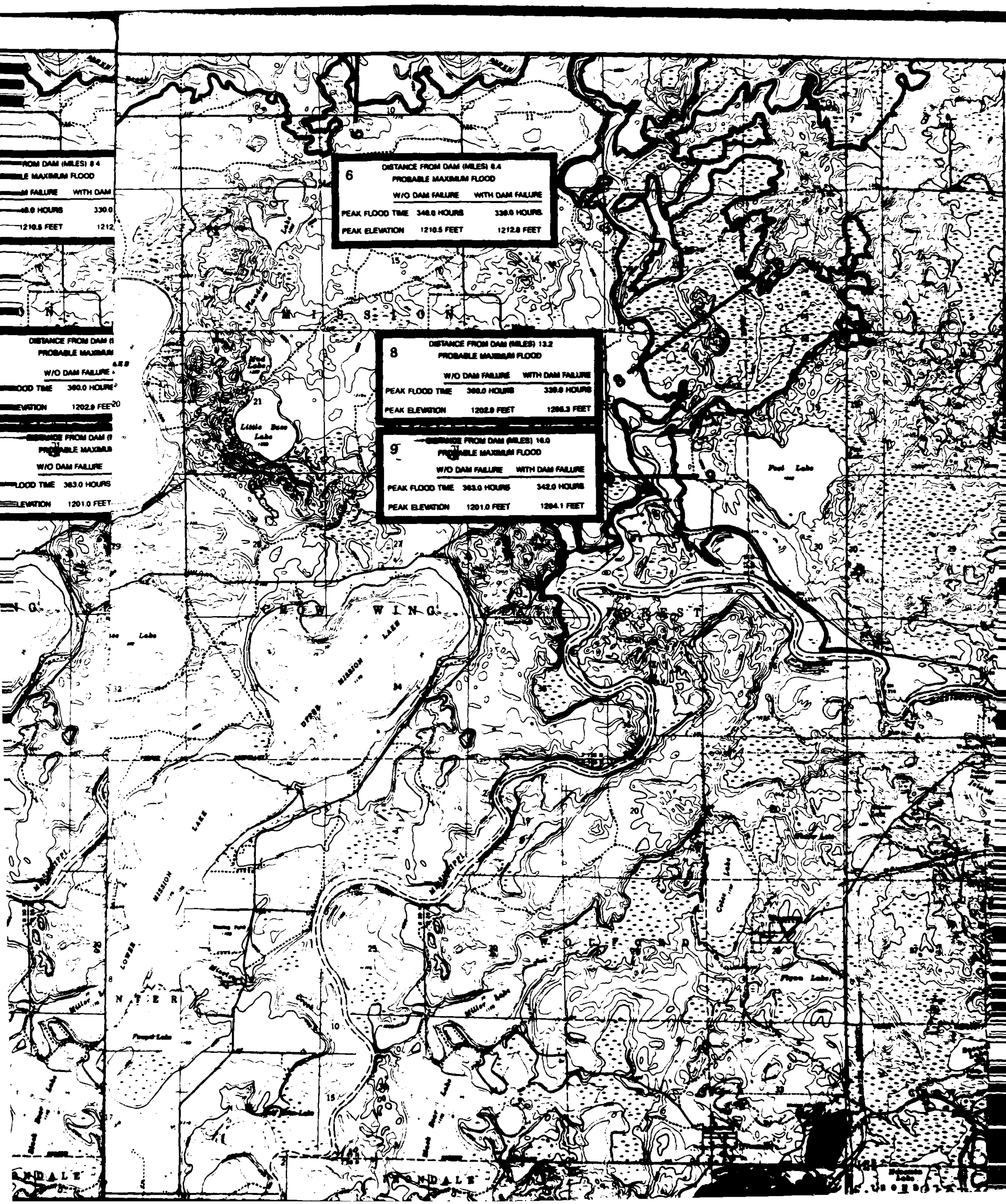
INUNDATION MAP

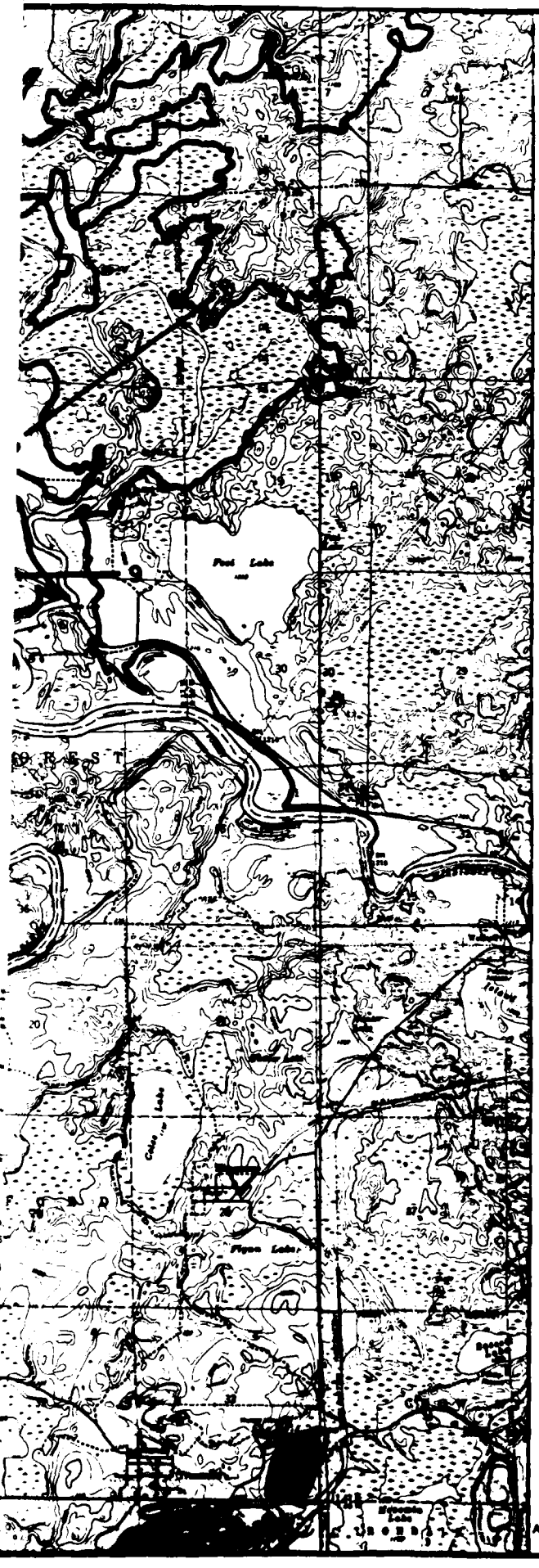
APRIL 1989

PLATE NO. D-2

3


6
PEAK FLOOD
PEAK ELEVATI
T E F O R E S T
L A K E
C A N
P E L I C A N
Lizard Lake
HORSESHOE
LAKE
Little Bass Lake
Bass Lake
Duck Lake
Perch Lake
Taylor Lake
LOWER
MISSION
LAKE
C E N T E R
CENTER
LAKE EDWARD
Silver Lake


6
DISTANCE FROM DAM (MILES) 8.4
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 348.0 HOURS 330.0 HOURS
PEAK ELEVATION 1210.5 FEET 1212.8 FEET
8
DISTANCE FROM DAM (MILES) 13.2
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 360.0 HOURS 339.0 HOURS
PEAK ELEVATION 1202.9 FEET 1206.3 FEET
9
DISTANCE FROM DAM (MILES) 16.0
PROBABLE MAXIMUM FLOOD
W/O DAM FAILURE WITH DAM FAILURE
PEAK FLOOD TIME 363.0 HOURS 342.0 HOURS
PEAK ELEVATION 1201.0 FEET 1204.1 FEET



N

LEGEND

Limit of Probable Maximum Flood Without Dam Failure

Limit of Probable Maximum Flood With Dam Failure

32 — 32 Cross Section

Corporate Limits

7000 0 2000 4000 6000

SCALE IN FEET

Contour interval 10 feet.

National Geodetic vertical datum of 1929.

Source of base map: U. S. Geological Survey 7.5 minute series, Cayuna, 1973
Pelican, Trommald, 1999

NOTE: The inundated areas shown on this map reflect events of an extremely remote nature. These results are not in any way intended to reflect upon the integrity of the Pine River Dam.

U. S. ARMY ENGINEER DISTRICT, ST. PAUL
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

PINE RIVER DAM
EMERGENCY ACTION PLAN
INUNDATION MAP

APRIL 1988

PLATE NO. D-3